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modern plastics

JULY 1940
VOLUME 17 NUMBER 11

AUGUST

Following our report on plastics in aircraft (see page 25) the August issue will feature an article on the availability of plastic materials should a national emergency arise. In response to many inquiries from our readers, we are preparing a survey of the industry to determine whether or not there will be a continuous production of plastics for military and naval material as well as for industrial, decorative and commercial uses.

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Cover color this month HAWAII VIOLET (Created by Textile Color Card Association

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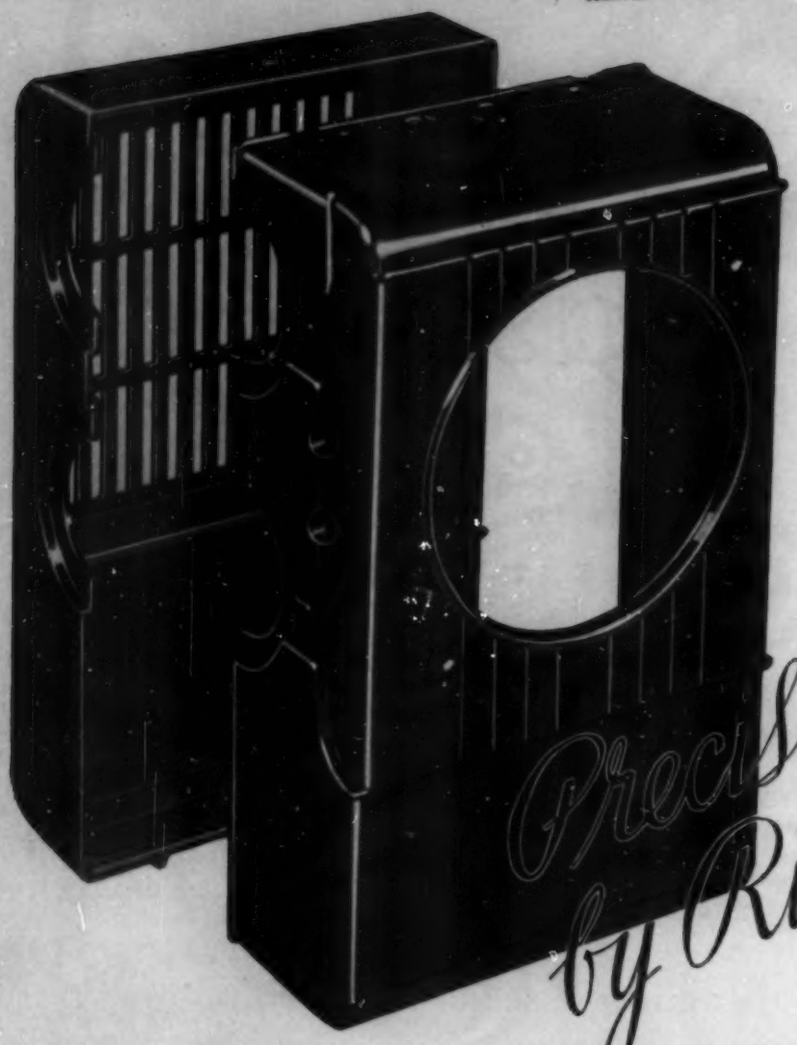

Illustrated is an INSUROK precision molded radio cabinet to house a miniature portable radio. 8½" x 5" x 4¼" in size, this beautifully designed cabinet weighs only 17 ounces.
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MODERN PLASTICS
W. T. CRUSE, Editor

JULY 1940 VOLUME 17 NUMBER 11

Molded airplanes for defense

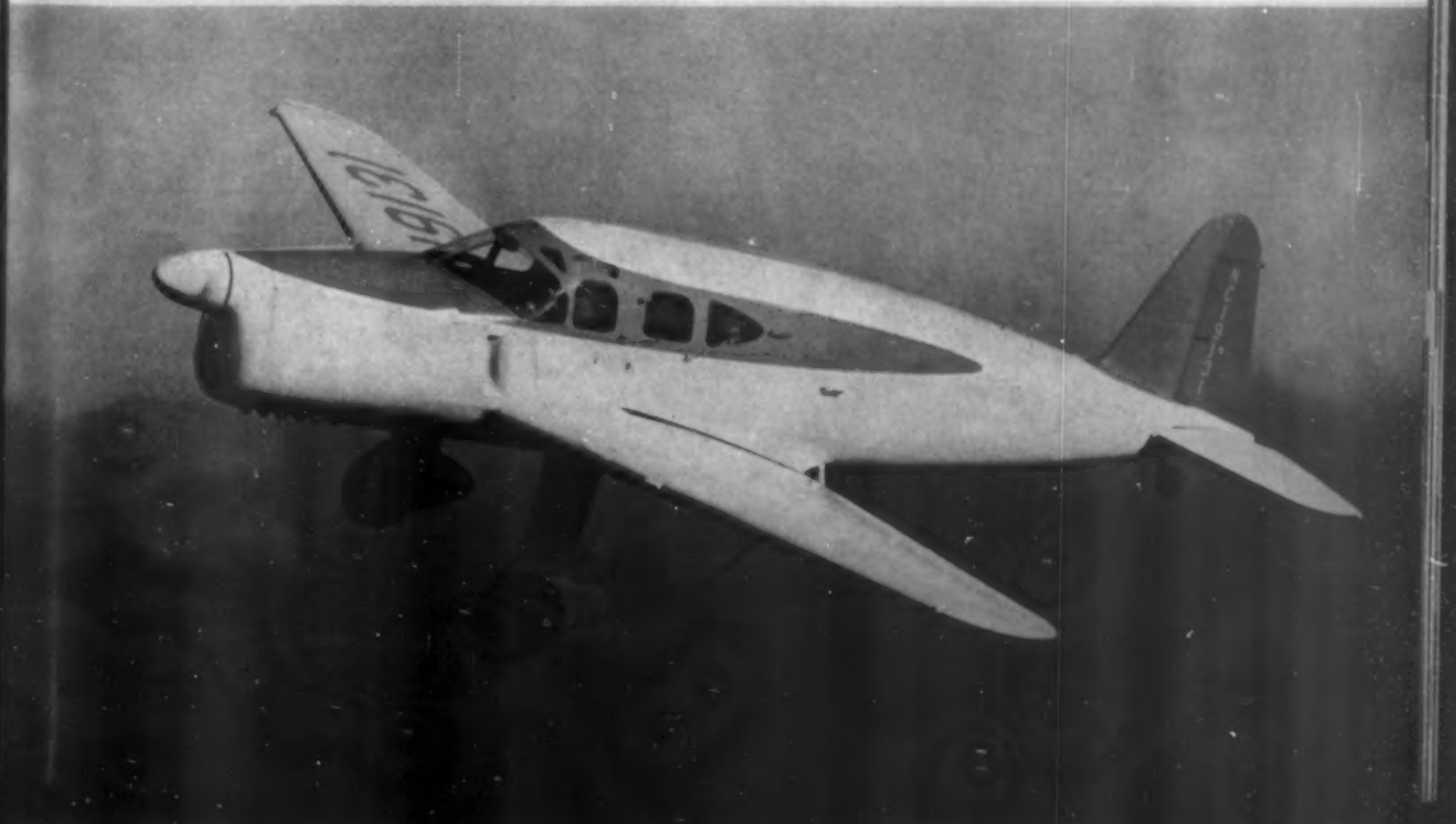
THE problem of molding airplanes is being aggressively attacked by four aircraft companies in the United States today and is being kept under an attentive surveillance by many other units in the industry. The Army Air Corps and the Navy Bureau of Aeronautics are closely watching these developments and even stimulating them by authorizing tests in their respective laboratories on full-sized molded structures with a view toward granting orders for small quantities to test production facilities. In addition, two major research institutions in this country have definite projects under way to make available engineering data on the properties of molded reinforced plastics and to investigate the available resins and fibrous strength elements in order to permit the selection of the best materials for the job and to secure the optimum assembling and curing conditions.

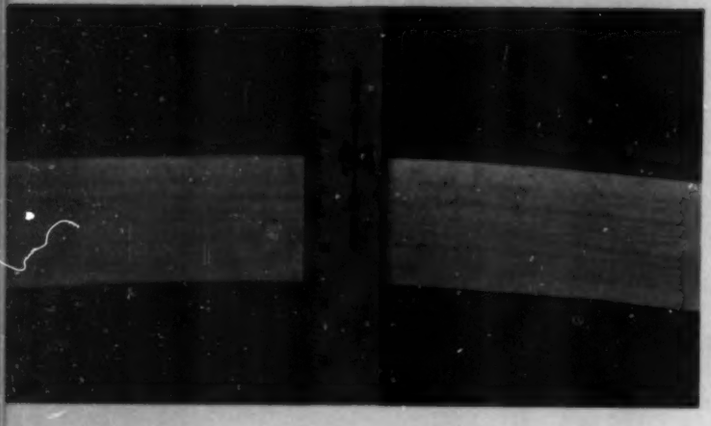
One of these research groups is working at the Mellon Institute under a fellowship established by the Glenn L. Martin Co. The most recent report concerning this work stated that "Advantages ascribed to the plastics form of construction include low cost of fabrication, high speed of production, good mechanical stability for a given weight, and excellent surface smoothness. The rapid molding of airplanes from plastics may ultimately supplant slower riveting and welding from metals, thereby facilitating mass production. Various plastics of the thermosetting fibrous-filler type have been prepared and tested, primary attention being given to materials of low specific gravity. An investigation of special molding methods is under way."[1]

The other research group is working in the Plastics Section of the National Bureau of Standards on a project sponsored by the National Advisory Committee for Aeronautics. The following summary of the work accomplished during 1939 is abstracted from the latest

[1] Researches of the Mellon Institute 1939–40, News Edition of the American Chemical Society, *18*, 287–300 (Apr. 10, 1940).

Plastic-plywood construction assures long service life for aircraft. It will maintain its stable dimensions and weather-resistance without appreciable depreciation in various climates. Smooth contours of compound curvatures and splendid aerodynamic features are demonstrated in the fuselage of the Fairchild 5-place Model 46 private plane pictured below





annual report of the N. A. C. A.[5] "Eighteen synthetic resins have been tested to determine their suitability for impregnating and bonding wood veneers to form a reinforced plastic of the requisite strength and stability for use in aircraft construction. Great differences were observed in the temperatures and pressures required for obtaining satisfactory bonds with these resins and in their degree of resistance to delaminating when alternately wetted and dried. On the basis of these data three of these resins have been selected for use as bonding and impregnating agents in the preparation of laboratory samples of reinforced plastics for strength tests. Tensile and compressive strength, modulus of elasticity, and water absorption have also been determined for a number of plastics which have been proposed by various commercial sources for use in building propellers, floats, spars, wings, and fuselages of airplanes. The reinforcing agents in these products included wood veneer, pressed wood, flax, jute, and sisal. The results indicated that maximum strength and stiffness is attained with well-oriented fibers and thermosetting resins."

The publications of these research groups at the National Bureau of Standards and the Mellon Institute will fill a definite need for factual information on the physical properties of the reinforced plastics.

The four companies which have been more than merely interested in plastics as aircraft structural materials and have made a considerable investment in plant facilities for their production are Fairchild Engine and Airplane Corp., Hughes Aircraft Division of the Hughes Tool Co., Aircraft Research Corp., and the Timm Aircraft Co. All of these firms have utilized wood veneers as the fibrous reinforcing agent and have used synthetic

2—Interior view of an experimental plastic-plywood nacelle produced by the Duramold process for transport planes. 3—Close-up of a 2¼ in. thick spar flange section made by Haskelite Mfg. Corp. There are six plies of ⅜ in. spruce with all grain parallel. Width is 2½ in., length 130 inches

The march of progress in the use of plastics in building aircraft has been continuously reported in the columns of this magazine. A survey of the potentialities of this mode of construction, made for the Institute of the Aeronautical Sciences, was published in our August and September 1938 issues.[2] Advances in the technology of utilizing plastics in molding aircraft were reviewed in our March 1939 issue.[3] A thorough discussion of the advantages of plastic plywood with respect to stability, simplification of design, and mass production, was presented in our September 1939 issue.[4] Important strides have been made in this application of plastics since this last report was published. In view of the vital relation of these developments to the present emergency national defense program, another chapter in this interesting current history of the plastic airplane has been prepared to bring us all up to date on this subject.

resins of various types as the bonding and stabilizing agents. In each instance the plastic properties of the resins have been used to mold the body of the airplane and to set it in the desired shape. This is one of the essential differences between the plastic-plywood type of construction now used in molding airplanes and the old-time method of gluing the veneers together in a flat press, and then wetting or steaming the flat sheet and springing it into the requisite form. Mr. J. T. Hartson, vice president of the Glenn L. Martin Co., says in a letter recently addressed to us, "It can be readily seen that this new process of forming the plywood relieves all internal strains, and the resulting product thereby remains stable and retains its shape during changes of atmospheric conditions. In the older type, where flat pressed plywood was steamed to compound curvature, there was always a tendency of the plywood to return to its original pressed condition and, therefore, the airplane changed shape, or wrinkled, with each change in atmospheric humidity and temperature." Of course, the new synthetic resin adhesives, which are proof against attack by molds, fungi water, oil and gasoline, are also an essential element in the success of the new plastic-plywood structural material in the aircraft field.

Details concerning the processes developed by each of the four companies mentioned above and employed by them in the production of molded aircraft will be given in the following paragraphs.

[2] "Plastics as Structural Materials for Aircraft," by G. M. Kline. MODERN PLASTICS *15*, 35–6, 62 (Aug. 1938); *16*, 44–6, 66 (Sept. 1938).
[3] "The Plastic Airplane." MODERN PLASTICS *16*, 44, 66–70 (Mar. 1939).
[4] "Structural Considerations Favoring Plastics in Aircraft Structures," by C. F. Marschner. MODERN PLASTICS *17*, 41–44, 68–70 (Sept. 1939).
[5] Twenty-fifth Annual Report of the National Advisory Committee for Aeronautics 1939. Available from the Superintendent of Documents, Government Printing Office, Washington, D. C. for 20 cents.

Fairchild Engine and Airplane Corporation

Vance Breeze, well-known test pilot, over five years ago suggested to Sherman Fairchild, President of Fairchild Engine and Airplane Corp., the possibilities of a plastic-plywood airplane. He pointed out how through readily molded streamlined shapes and forms, with overall exterior sheen smoothness, aerodynamic drag could be minimized and a cheap simple structure developed to reduce the cost of airplane manufacture.

Concurrently, Colonel V. E. Clark, commissioned by Mr. Fairchild to find better and cheaper materials and processes for plane construction, had set out to investigate various rivetless possibilities. His search brought him to the front door of plastic-plywood. This material was not entirely new to Clark as he had built wood and glue monocoque fuselages during the last war. He

5

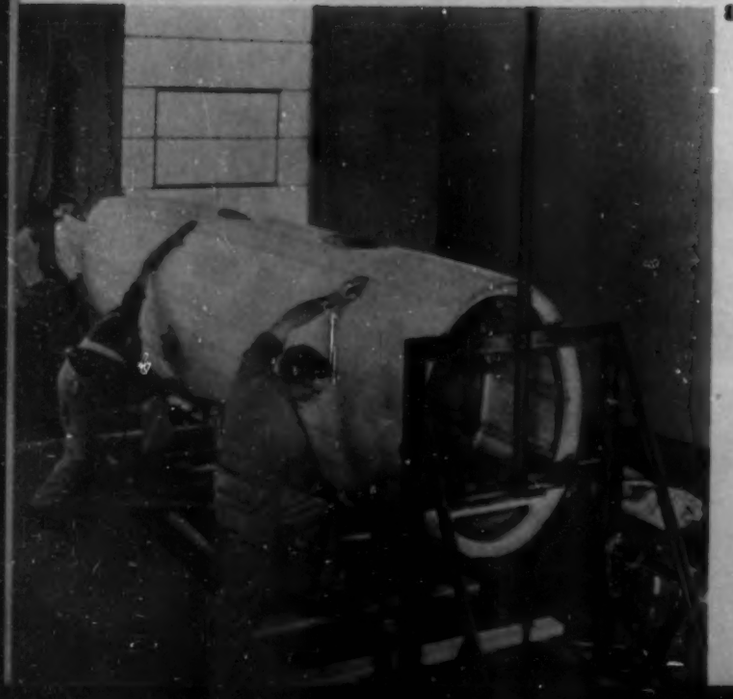
4

4—First all-molded airplane, the Summit, was made by the Vidal process with wings, fuselage, tail assembly and controls molded as complete structures in themselves. 5—No fastenings are used in the plane's fuselage (end view) which has ribs, stringers, pads, etc., all molded simultaneously

6

WIDE WORLD PHOTO

7



8

6—Timm, low wing monoplane primary trainer, built by the Aermold process, is essentially thin spruce plies, 1/21 in. thick, impregnated with phenolic resin and laminated and shaped in a precision mold. 7—After formation of the plywood veneer, the plastic is pressure-sprayed on the surface so that a complete saturation and binding of the layers are effected. 8—The fuselage, formed of two exactly matching molded halves, is rapidly slipped into the structural framework. Each half extends over the entire expanse from nose to tail. 9—All component parts such as the fuselage (left) and wing section (right) are baked at high temperature under controlled heat and humidity in a large oven which measures 10 ft. wide, 10 ft. high and 40 ft. deep inside. This specially constructed oven was manufactured by Despatch Oven Company

9

had always been enthusiastic about the possibilities of wood except for the limitations of the then available glues. Here their efforts did not end. The horizons beyond were carefully explored—all the known factual data were assembled, preliminary laboratory tests were made, and a course for action was charted. Working with the Haskelite Manufacturing Corp., the Duramold Aircraft Corp. constructed a five-place plane, known as the Fairchild Model 46. It had a molded fuselage. The wing structures were of wood with resin-bonded plywood covering. The plane was flown in August 1937 and has approval No. 2-545 issued by the Civil Aeronautics Authority. It was assembled in Hagerstown, Maryland, and is today in active service.

The fuselage of this plane was formed by placing veneers cut to gore shapes one layer upon another over a cast-iron die with phenolic resin interposed between each layer. Surmounting the composite was placed an air bag under pressure. The mass was cured by heat from steam passed into the cast-iron die. This experimental technique has now been abandoned. The die cost was uneconomical.

In 1939 an exclusive license on large aircraft was sold to Hughes Aircraft Division of Hughes Tool Co., Los Angeles. Simultaneously Duramold Aircraft Corp. became a 100 percent owned subsidiary of Fairchild Engine and Airplane Corporation.

Duramold as a process is today jointly controlled by Haskelite and Fairchild, except for the license to Hughes. The interesting non-aviation potentialities are allocated to Haskelite. All aviation developments and production are assigned to Fairchild or Hughes.

The Duramold method requires, like any molding processes, first a form or mold. Unlike conventional practice, the female part permits liberal selection of material; sheet steel, cast metal or wood may be used. This is the non-flexible half. The determining factors for size and construction are the dimensions of the part to be constructed and the quantity to be produced. The male or flexible half of the die is a rubber bag. The non-flexible die gives the solid base for the shape and for applying pressure. The flexible die assures equal pressure all over the surface and gives at all points of curved surfaces pressures that are directed at right angles to the surface. This feature cannot be duplicated by the application of pressure by means of hydraulic or mechanical presses. By this method uniform pressure is applied at all points on compound curved surfaces.

The part to be molded, be it fuselage, wing, nacelle, pontoon or spar, is placed over the form—a layer of wood, a layer of plastic, a layer of wood and another layer of plastic and so on until the desired thickness is built up. Over the whole is then placed the retaining bag. The assembled aggregate is then placed in the tank and pressure is applied. This is accomplished with steam at 110 lbs. per square inch. The length of cure is variable. Temperatures and length of cure are experimentally determined by measurements with thermocouples, which are installed inside the panels in thick

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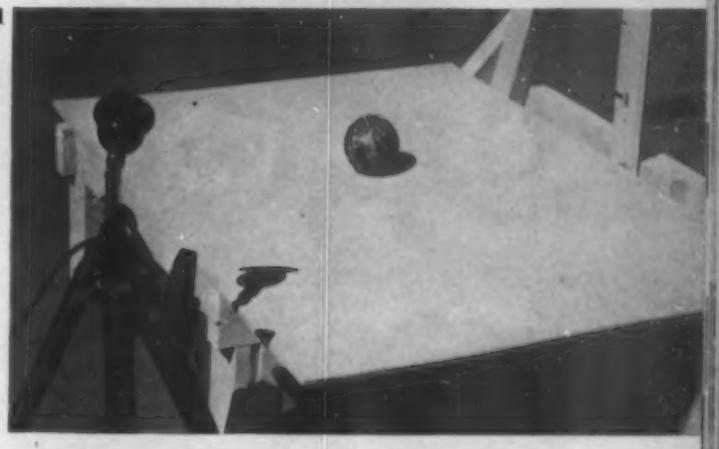

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To demonstrate Timm aircraft material's strength and resistance to shock, an 8-lb. ball was dropped 7 ft. onto a sheet of standard aircraft metal and on the plastic-plywood.* 10—*Pictured at the exact point of contact, the metal sheet was depressed 8 in. and was distorted by the impact.* 11—*The plastic material shows no sign of a blow other than a slight indentation, even after the ball bounded 2 ft. into the air.* 12—*The results of subjecting standard aircraft metal (left) and a plastic sheet (right) to the searing of a 1400 deg. oxy-acetylene flame are shown. Note the plastic is untouched while the metal has a jagged hole

13

In this new Bell Airacuda multi-place bomber, lightweight, shock- and wind-resistant, almost unbreakable, clear Plexiglas sheets are used for navigation cockpit windows and cockpit enclosures. This construction substantially increased all-around visibility

sections of one-half inch or more. Once the optimum conditions are found for a piece of the desired size, then the predetermined temperature and pressure are maintained in production. Generally speaking, on thin sections of from 1/8 in. to 1/2 in., it is not necessary to predetermine cure. About 15 minutes are required. When the molds and part are taken from the oven and the part removed, it is finished except for the surface treatment operation.

The most successful plastic bonding agent the company has used is of the thermosetting type. Both viscous dopes and sheets of phenol-formaldehyde resin have been employed. The glue lines by laboratory test and by the more critical standard of actual experience are as strong as the wood.

Mr. Alfred A. Gassner, Chief Engineer of the company, enumerates some of the features of Duramold plastic-plywood, as follows:

1. The process permits design and construction of monocoque-shell type of aircraft parts such as wings, fuselages, tail surfaces, cowlings and the like, with the structural material distributed to its best advantage and with secondary reinforcing members like stringers and ribs either entirely eliminated or greatly reduced in number as compared to present-day type of construction. A thick skin can be left which is by itself able to carry large compression, shear or tensile stresses, because of the comparatively low density of the construction material. The specific gravity of mahogany-base Duramold is 0.52 compared with a specific gravity of about 2.80 for aluminum alloy. The skin thickness can, therefore, be about 5.4 times the thickness of such a material for the same weight.

In compression-buckling the determining factor is the EI value, or the product of modulus of elasticity times the moment of inertia of the member. For aluminum alloy E = 10,300,000 lbs. per sq. in., for the mahogany-base material E = 1,100,000 lbs. per sq. in. But the moment of inertia I is equal to t3/12 for unit length, and the thickness "t" for Duramold can be 5.4 times the thickness of the aluminum alloy plate. At same weight the plastic-plywood shell would be more than 2.5 times stronger in compression than the unreinforced metal shell, and it would be by 15 to 20 percent stronger than a metal shell reinforced by long stringers.

2. Riveting is eliminated, and with it all the un-

evenness of the surfaces of wings or fuselages. Lap or seam joints of sheets with their detrimental effect on drag, are avoided. These two factors, rivets and sheet seams, increase the drag of a production-type all metal-wing by from 30 to 50 percent over the drag of a perfectly smooth wing in wind tunnel tests. A thin-skin all-metal wing also tends to develop wrinkles or undulations under air loads. The thick-skin Duramold wing is free of such wrinkles under normal flight loads.

Fairchild P. T. 19 Trainers now in quantity production are equipped with spars of plastic plywood. Duramold spars are molded from short lengths of spruce or, in some instances, of other types of wood. They have equal or greater strength than could be obtained in using virgin wood. Plane manufacturers are, therefore, no longer dependent upon the limited supply of long-length straight-grained spruce. Curiously, the cost of molded spars is less than that of cut and trimmed spars, made of one piece of solid spruce.

The Duramold Aircraft Corp. has produced experimental nacelles. The antenna housings on a major airline fleet are this company's product. Production of larger aircraft parts is a near reality. Tanks or ovens large enough to handle full-sized wings and fuselages are on order. One tank, 10 ft. in diameter and 28 ft. long, will soon be installed. The quick-acting door of this tank weighs 13 tons. An abundance of stress-strain data has been accumulated, assembled, and worked up into the engineering formulas required for production.

Aircraft Research Corporation

Prominent among the companies which have extensively explored with more than pilot production success the use of plastics in manufacturing airplanes is the Aircraft Research Corp. of Bendix, New Jersey. This company molded a small two-place airplane which has been flying for several months and which is now being tested by the CAA. It also has both Army and Navy contracts and recently completed a molded combat plane for the Army Air Corps.

Aircraft Research Corp., organized three years ago by Gene Vidal, has been molding aircraft and other structures using plastics for two and one-half years. During this period of experiment and development, weathering, strength and other tests have been conducted for improving both structures and material.

The company, by contract, constructed the forms and molded the body of the Summit plane, which has been flying for several months and which is now undergoing CAA tests. It is the first completely molded airplane *body* in the United States, and, to our knowledge, the first in the world. The wings, fuselage, tail assembly and controls were molded as complete structures.

Aircraft Research Corporation was granted a development contract last July from the United States Army Air Corps and next month will have completed the design, forms and molding of a Basic Trainer airplane. The company has a contract for floats for the United States Navy Bureau of Aeronautics and has already delivered a number of main and wing-tip floats for various types of service and severe practical tests.

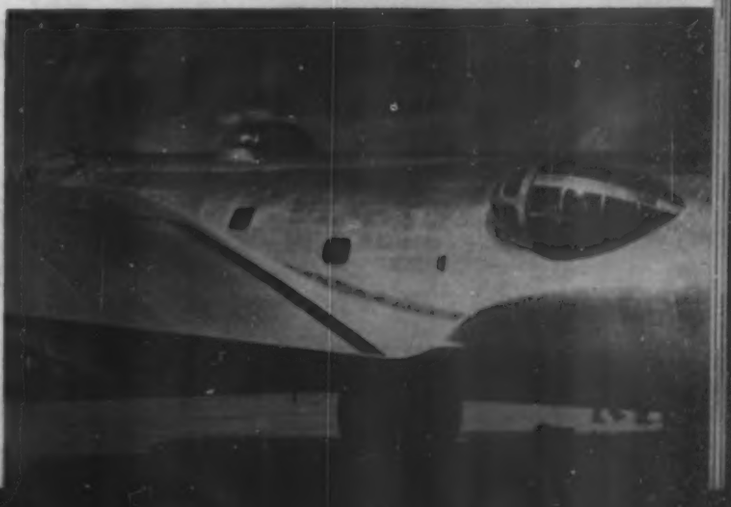
They have developed, molded and tested boats, skis, racquets, automobile parts, etc., using the same process. The United States Plywood Corp. is the company's exclusive licensee for the manufacture and sale of boats, automobile parts and skis, and these products are now being made and sold. U. S. Plywood Co. is also a non-exclusive licensee for aircraft parts and is now installing its fifth large pressure tank at Algoma, Wisconsin. A variety of other products, which have promise, are being developed at this time.

The *Vidal Process*, as the Aircraft Research Corp.'s method is designated, is primarily a method of molding, under a fluid pressure and heat, plastic and a reinforcing material such as veneer, which have been placed in the slots of and wrapped about the inexpensive but properly contoured and slotted wooden forms, in such a manner that completely reinforced structures with skin and structural members welded simultaneously into a single unit are the result of the "cooking."

(*Please turn to page 78*)

***14**—Transparent acrylic nose section of this Lockheed transport increased radio reception and reduced the parasite drag of antenna enclosed.* ***15**—Boeing "Flying Fortress" with plastic commander's dome (top). Side "blister" formed of acrylic resin sheet enables machine gunner to sight and fire from the rear*

14



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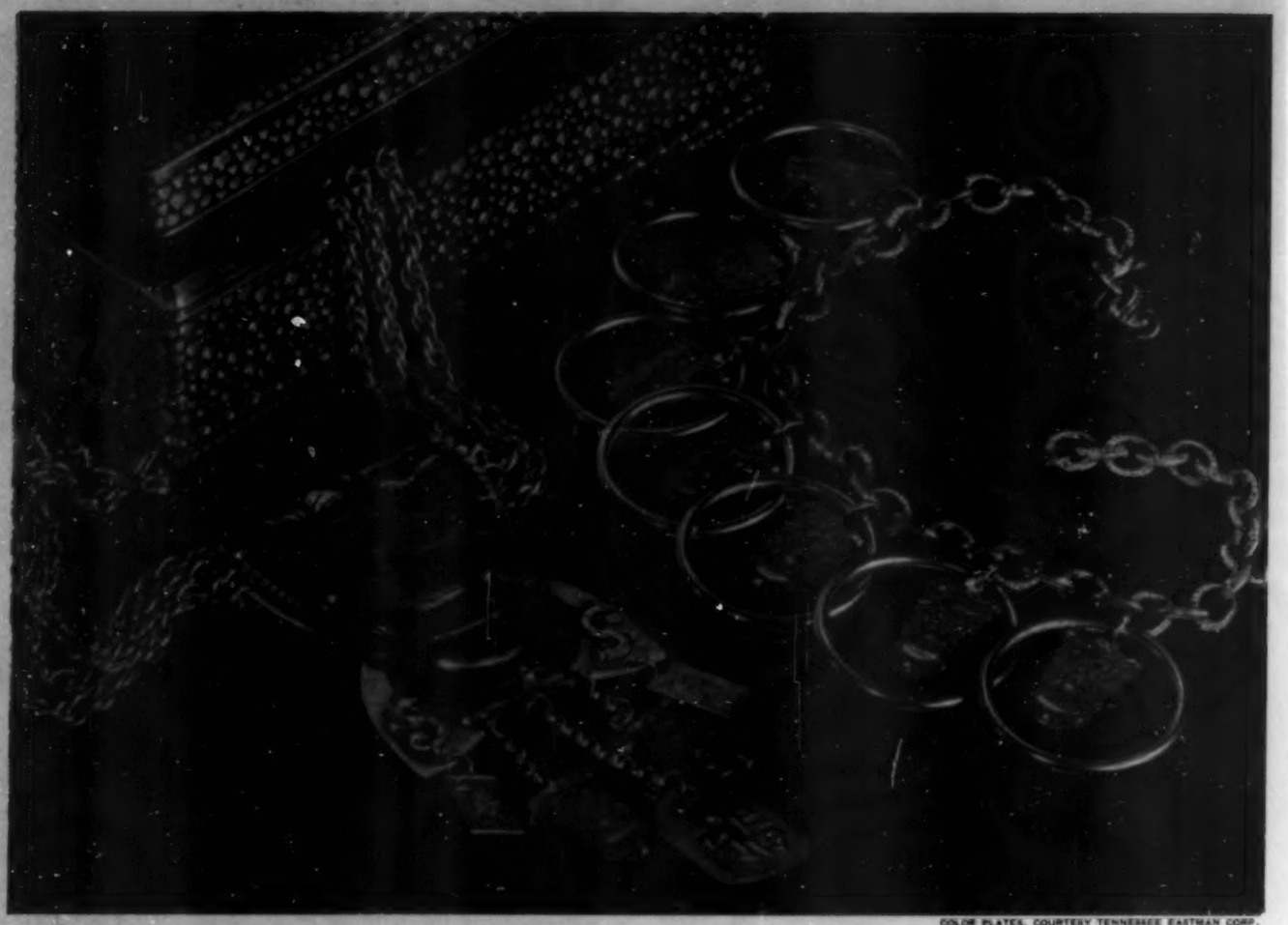


COLOR PLATES, COURTESY TENNESSEE EASTMAN CORP.

Strikingly true replicas (above) of antique oriental jewelry combine gold metal with carnelian plastic medallions which duplicate in exact detail the Chinese symbol of prosperity—a pot of peonies. Injection molded of Tenite by Thomas Mason & Company

The costume jewelry way

by EVE MAIN

ONCE upon a time the jewel box of ordinary mortals, even as you and I, held a cherished collection of trinkets gathered together through the years. Rings, a gold bracelet, a locket and chain, a brooch or two set with tiny stones, pearls, and perhaps a few strings of beads, all of them more than likely commemorating some special event—birthdays, graduation, engagement, anniversaries and the like. Then came *costume jewelry*—colorful, decorative, inexpensive—and today, the same jewel box could hardly begin to accommodate the treasure trove of necklaces, bracelets, clips and pin-on gadgets chosen as accessories for each outfit in the closet.

Six years ago it was reported "through usually reliable sources" that 75 percent of all the costume jewelry sold in department, specialty and other stores, was made of cast phenolic plastic material. Smartly shaped, skillfully carved, its jewel-like color and brilliance sparkled from the hair, neck, shoulder and wrist of well-dressed women everywhere. So popular did it become that it seemed a natural for jewelry manufacturers for many years to come.

But Dame Fashion, being the fickle mistress she is, had other plans and lavishly bestowed favor successively on wood, nuts, and seeds, glass, cork and metal, until plastic trinkets had to take a much lower place in her court.

About a year ago, however, the plastic pendulum started an upward swing—slowly, slowly at first but gradually gathering momentum until this spring it hit

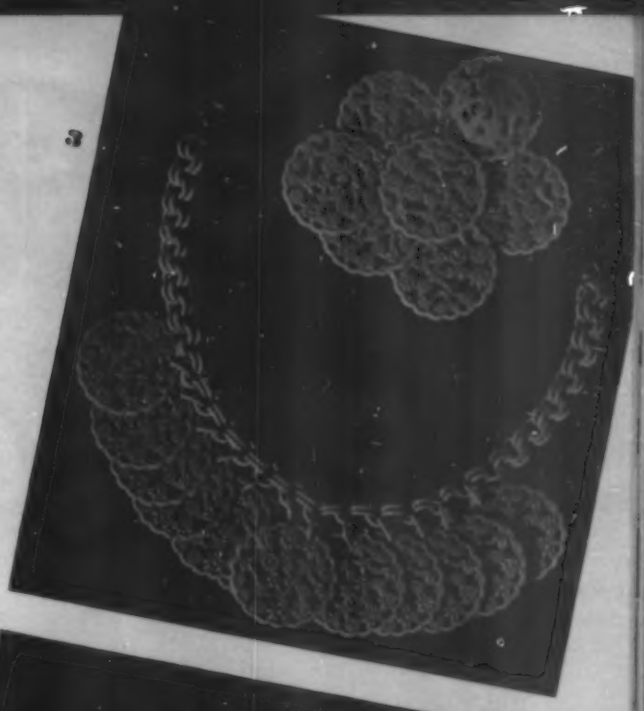
the top with a bang, flooding the style world with a gay mass of cleverly designed, beautifully colored costume complementers. Right up in front this time is a different type of plastic—cellulose acetate, made practical for jewelry production through the injection molding process. The first of these pieces to appear on the market caused no particular enthusiasm, possibly because they were more or less of an experiment and not a great deal of thought was given to the matter of interesting, salable design. Flower petals, leaves and all flat surfaces were thin to the point of flimsiness. Actually they looked cheap and were, as compared with the latest crop of pretties.

Joseff, of Hollywood, designer and producer of spectacular movie jewelry, was among the first to seriously undertake the creation of really distinctive pieces by this method, for commercial sale.[1] His necklaces, pins and ornaments expertly combining metal with injection molded parts in well-chosen colors have a quality look that makes them welcome in the most exclusive circles.

The fascinating collection of American adaptations of Chinese jewelry presented by Lord & Taylor last fall, marks another high spot in the molded plastics' record. This costume jewelry fashion, promoted by Mrs. Theodore Roosevelt, Jr., Mrs. Roy Howard, and Mrs. Paul Cravath for the purpose of raising money for

[1] MODERN PLASTICS, September 1939, page 30.

2



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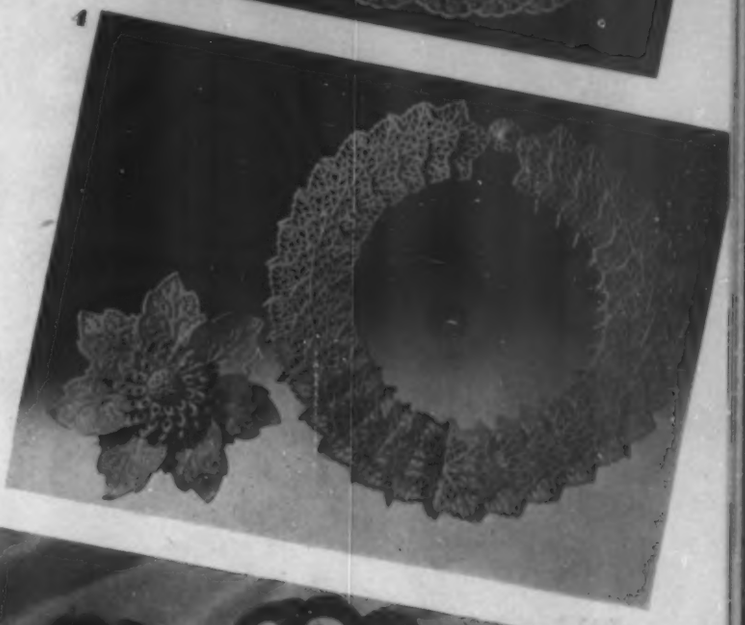

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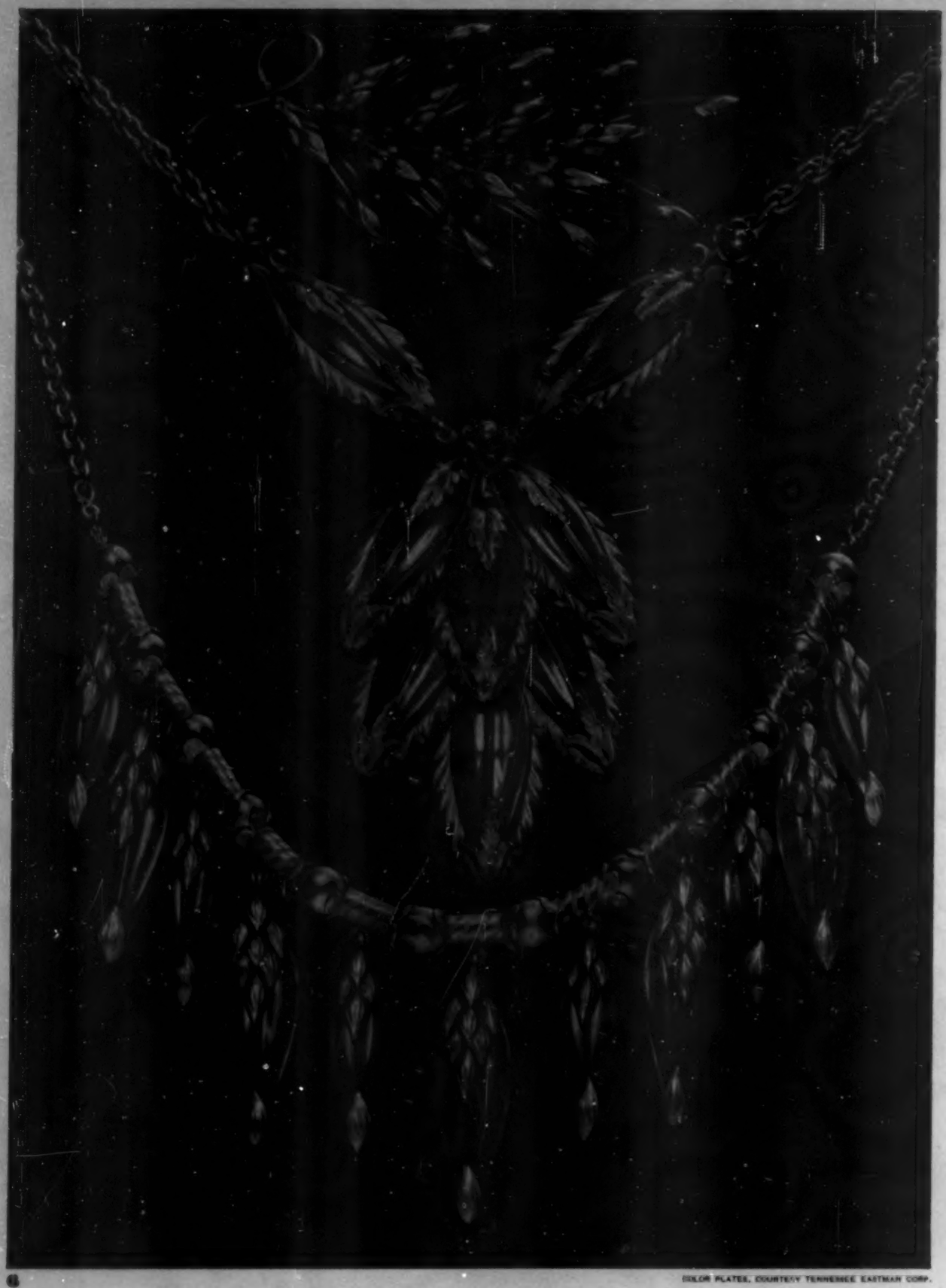
2—Gladys Swarthout wears a Chinese bangle necklace of gold and molded Tenite peony pendants, with earrings to match. Martha Sleeper chooses a dainty floral pattern for a fashionably bulky necklace and pin 3, designed for D. Lisner & Co. and injection molded of Lumarith by Geo. F. Berkander

4—Reminiscent of lavender and old lace are the delicate pin and flat collar-like necklace injection molded of cellulose acetate. (Photo courtesy Celluloid Corp.) 5—Soft purple and bright yellow pansies in cuff-link, stud, button and clip sizes are injection molded of Lumarith by Berkman Button Co. for Bailey, Green & Elger, Incorporated



8 COLOR PLATES, COURTESY TENNESSEE EASTMAN CORP.

With one pattern of plastic medallions, injection molded in large and small sizes, Joseff of Hollywood turns out a series of necklaces, pins, earrings and bracelets that are refreshingly original. By ingenious coupling of plastic color and antique metal mountings—black and silver, summer-sky blue and gold, leaf green and gold, orchid and silver, turquoise and silver and coral and gold, to mention a few—each design has a personal charm all its own. The little plastic ornaments are injection molded of Tenite by Gillum & Co. for Joseff

Mme. Chiang Kai-Shek's war orphans' fund, was inspired by the famous antique Jade exhibition, held at the Arden Gallery for the same cause. A royalty from the sale of each piece goes to aid the homeless and starving babies in the war areas of China.

The modern settings and assemblies were created by Ernest Steiner, jewelry designer, who made necklaces, bracelets, lockets, earrings and pins of antique gold and silver metal. Many of them are decorated with jade, carnelian and lapis lazuli plastic medallions which are injection molded replicas of two of the better known Chinese symbols—"Eastern Chow," meaning good luck, and "The Peonies of Prosperity," which are supposed to bring the wearer material good fortune.

Because of the full color range of the cellulose acetate plastic material selected to execute these Chinese designs, the manufacturers were able to precisely duplicate the subtle shades and configurations of genuine jade, lapis lazuli and carnelian. The original pieces shown at the Arden Gallery were used as models by the die maker in order that the plastic copies might be exact in every detail, and polished steel molds give the pieces a lustrous, jewel-like finish.

There's almost no end to the size, shape and intricacy of motif which can be reproduced in plastics by the injection molding method. Delicate, lacy patterns come from the machine with the same perfection of contour and detail as do solid flowers, vegetables and fruit in miniature, and geometrical forms. Some of the costume pieces are made up of big, bulky dangles, not nearly as heavy as they look; others string together thin, cut-out chips into a flat collar. Some are fastened onto metal chains; others are bound together by plastic links. Some are in bright, flashy hues; others lean toward soft pastel shades. And there are whites galore at this season.

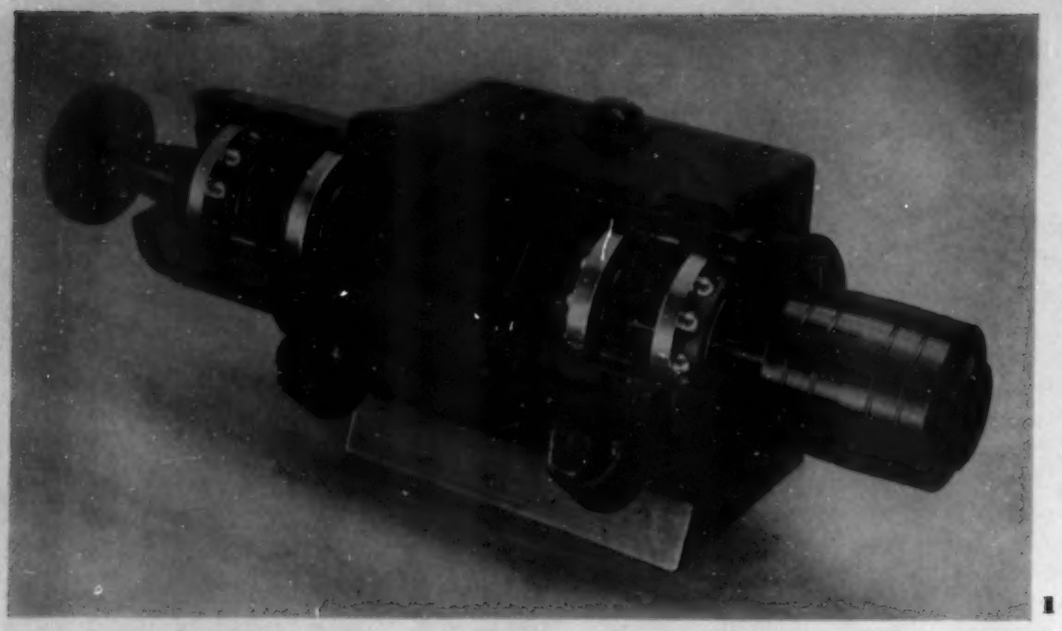
Good design is a noticeable feature in almost every display of this new version of plastic jewelry. Many of the sets seen on costume accessories counters are tagged "Martha Sleeper." It was Miss Sleeper, a promising young actress turned designer, who made it an adventure to wear hat and lapel ornaments, what with her conversation-provoking birds, bugs and beasties fabricated from cast phenolic material. Her treatment of cellulose acetate plastic jewelry is every bit as original and refreshing. And almost all of the designs presented are on the same high plane.

Other types of plastics are represented in the abundant spring and summer showings of costume jewelry besides those already mentioned. There are matching sets ingeniously fashioned (*Please turn to page 82*)

7

8

7—The Rumbola rainbow-colored strands are twisted into a soft cord, tipped at each end with miniature maracas, gay with painted South American scenes. The little maracas (that really rattle) are injection molded of Tenite by Ben-Hur Products, Inc. 8—A necklace and bracelet in soft, white satiny luster, fashioned from Lucite, are a flattering complement to a simple blue frock trimmed with white. (Joseph H. Meyer Bros.) Incidentally, the young lady holds a crystal-clear walking stick with ruby-red crook, made from the same plastic (Deauville Bag Co. by Ortho Plastics Co.), wears a hat with a wide brim of white cellulose acetate plastic (Louisesanders) and carries a bag (Koret, Inc.) with a Lucite frame



A sectional view of a high-speed machine spindle shows, at each end, the precision ball bearings with their Micarta retainers in place on the shaft. Light, but mechanically strong, the laminated retainers are shock-absorbing and quieter, and result in longer bearing life and in higher speeds

For super-speed service

Laminated phenolic provides accuracy, strength and better lubrication for heavy-duty ball bearing retainers

PERHAPS no feature of design of the present-day ball bearing is the subject of greater discussion than the retainer. Bearings have been carefully constructed, in the matter of ball size, race depths and curvature, wall thickness, etc., to meet almost every conceivable condition. Not so with retainers, however. For many years it was generally thought that one or two principal styles, with occasional variations for very special service, would meet all requirements. Only in late years have leading designers inclined more and more to the belief that retainer design and selection is deserving of fully as much consideration as the type and capacity of the bearing itself.

Retainers may be of steel, bronze or composition. This material may be either machined, pressed or, in rarer cases, molded. In construction, the retainer may be of the *finger*, *staked*, *riveted* or *one-piece* design.

To begin let's tabulate the characteristics this member must have in order to perform satisfactorily. It must be strong yet light; inexpensive to manufacture, though precise as to dimensions; economical to assemble, albeit accurate with respect to its parts and contiguous members. It must combine rigidity with resistance to fatigue; it must not hinder proper rolling of the balls nor cause undue friction. It must be so designed and made that it will not vibrate excessively or be noisy.

Standard retainers

For most ordinary applications, where high speed and close tolerances do not enter into the problem, *the pressed steel retainer* is satisfactory.

Where abnormal conditions of service exist, however, as in the case of severe loads and very high speeds, retainer construction and durability become increasingly important and often necessitate the employment of some type other than the *pressed steel*.

At high speeds, for instance, considerable stress is undergone by the retainer, due to the large inertia forces then operating. Vibration must be guarded against, this being one of the factors in a fatigue failure as well as a serious detriment to silent operation. A vibrating retainer cannot maintain positive or accurate contact with the balls. If the retainer pocket is not an accurate close fit there will also be a tendency toward noise from the constant hammering of balls against the retainer proper. To meet these requirements, a retainer has been developed and fabricated from laminated phenolic tube or plate.

These bearings are used principally in the spindles of high-speed machine tools for metal and wood working, some turning as high as 60,000 r. p. m. They are necessarily the most accurate bearings made today, balls being held to limits of five-millionths of an inch,

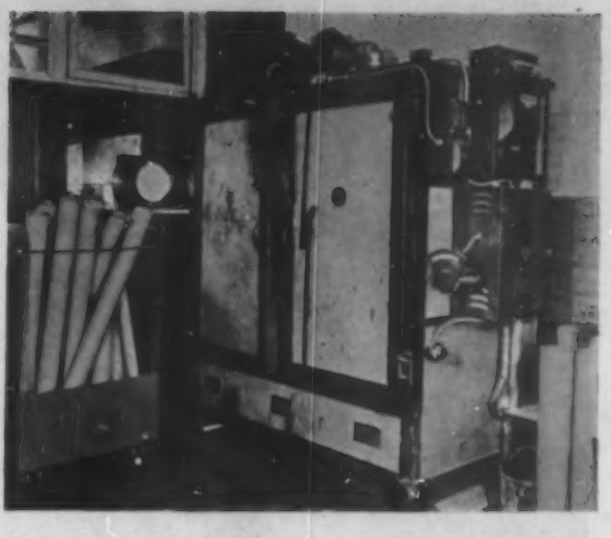
in some cases. Such high rotational speeds require absolutely concentric running truth and perfect balance of the bearing. In addition, lubrication becomes a major problem.

For reasonably high-speed service, two-piece machined bronze retainers have been satisfactory. For highest speeds, however, the laminated plastic retainer must be used. The advantages are, briefly:

1. Lightness plus great mechanical strength.
2. Being non-metallic, shock-absorbing plastic retainers are quieter.
3. Better lubrication since the laminate *wels* better than bronze.

The result is longer bearing life—from an average of a few weeks to as much as a year and a half of regular service. One such bearing, checked after 18,950,000,000 revolutions in high-speed grinder service, was found to be in good working condition and was reinstalled.

We would like to picture some of the more outstanding installations in which laminated bearings and retainers are giving service beyond all expectations but we find that those concerns using them are hesitant to be named at this time. Case histories, however, which are a matter of record, reveal the performances characteristic of plastic bearing materials and the qualities which make them supe- (*Please turn to page 90*)



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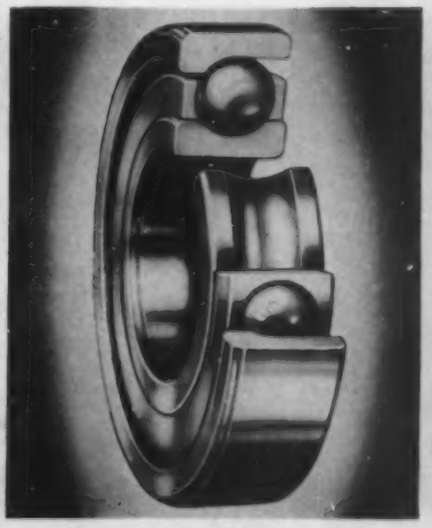
3

2—Before being fabricated into laminated phenolic retainers, tube stock is placed in an oven, under oil, and subjected to carefully regulated high temperature for a predetermined time. Oil stabilization process makes possible the machining of retainers to accurate, permanent dimensions that will not vary with age or temperature. 3—An automatic machine drills the ball holes in six retainers at one time. 4—A close-up of the standard one-piece Micarta ball-bearing retainer illustrates the construction. 5—This cross section of a bearing shows the conventional one-piece retainer in position. 6—The "split-type" retainer is fabricated in two separate halves which are riveted together during bearing assembly

4

5



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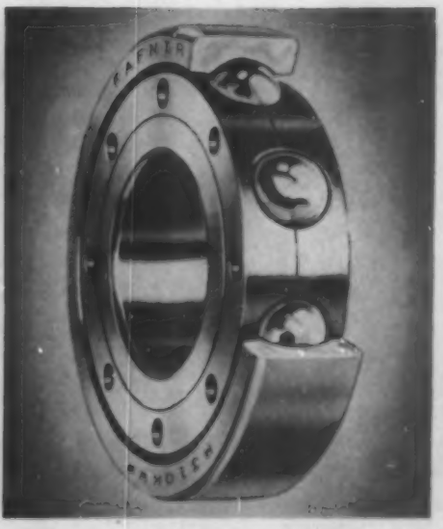


Transparent Lucite heads, molded by Boonton Molding Co., give a clear view of the beer conditioning process in the Whiting Draft-Rite beer control and cooling system. The china containers with their clear, plastic tops are pictured at left. Above—The crystal clarity, thickness and intricacy of the cap may be seen in this close-up view. Note the two threaded projections in the foreground which are 3/4 in. high, and the four rounded corners which hold the cap in position

Meeting engineering demands

ROUND and round through twisting coils the foamy liquid flows—a nothing-to-hide beer dispensing system, specially designed for the bar-front observation corps, permits a first-hand look at all the maneuvers.

Fully aware that the public is ever curious to "see how it works," the Whiting Corp., of Harvey, Ill., has developed a dispenser that will catch attention right at the bar and hold the customer's interest between rounds. A plate glass section built into the unit gives them a clear view, right down through crystal-clear methacrylate molded heads, directly into the cylinders from which the beer is drawn. Coil arrangements, cooling system and the whole process of conditioning draft beer are in plain sight through the top and open to discussion by kibitzers and connoisseurs.

Two white, vitrified china cooling cylinders feed each faucet in this *Draft-Rite* dispensing system. The transparent tops are clamped on and connecting pipes inserted through threaded openings. Observers can watch the beer as it flows into the first cylinder from the barrel and then into the second cylinder before being drawn off through the faucet.

Because of the complexity of pipes which conduct the beer through the plastic caps, from cylinder to cylinder, and out to the tap, it was necessary to plan precisely the position and size of the three openings in each cap. Outside threads are molded in. Inside threads are tapped in afterwards. Two openings are extended by 3/4-in. projections on which the metal nuts are screwed to hold the pipes in (*Please turn to page 90*)

Seaworthy pump

Molded phenolic protects the housing from salt water corrosion and electrolytic action

THE salty tang of the sea—fresh, invigorating and irresistible to weather-beaten tars and week-end skippers alike—is ruinous to the life of marine apparatus. Any device made for the marine field must withstand the action of salt water. Nearly all materials are allergic to it. Metals corrode in time; unprotected wood warps.

1

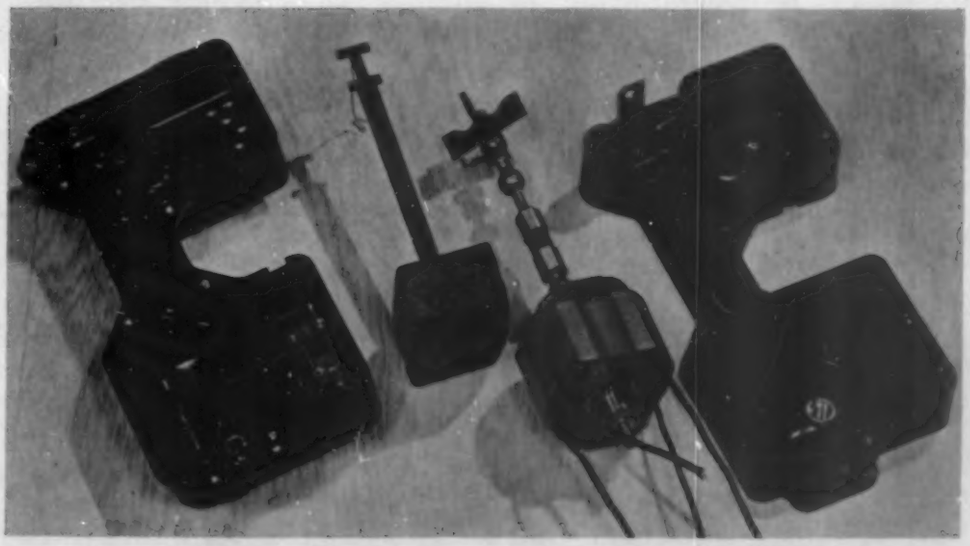
The problem is even more acute when electric currents are present, since electrolytic action is intensified. Paints and lacquers have helped somewhat on metals, but are effective for but one season or less. Phenolic plastics will withstand both the salt water and electric action—a vital factor for their consideration for the Geo. W. Fleming Co., Inc.'s, electric bilge pump.

Vital equipment for smooth sailing, to remove waste from the ship's bilge and keep it dry, a bilge pump is a difficult device to keep in good running order. It depends on battery current for operation. This means pumps made of metals or bronze may corrode, or, in case of a short, be eaten away by electrolytic action. The high dielectric strength and water resistance of the phenolic molded material eliminate such action. The case must be water- and oil-proof, have high abrasive resistance and toughness, as foul water, collecting in the bottom of a boat, frequently contains grease and foreign matter which attack the surface of the pump and pound at the housing.

One of the problems with this type of pump is that they run dry and most pumps depend upon water to lubricate the low bearing. In the Fleming pump a spherical type of bearing which is self-aligning and oil-impregnated is used. These bearings are slotted and the slot fits over a boss molded in one half of the case. The other half has a molded recess into which fits a felt oil-saturated pad in back of the top bearings for further lubricating them.

The inlet of the pump has the screen areas molded into the plastic case. The (*Please turn to page 92*)

2



1—Designed for dependable service, the Fleming electric bilge pump is housed in a two-piece oil- and water-resistant case molded of Durez by Oris Mfg. Co. 2—Molded-in screen areas, bosses and metal inserts are shown inside the half at left. Float and steel armature shaft are in the center

2

3

PLASTICS IN REVIEW

5

7

8

1 Have an apple a day cored and sliced with this brightly colored Hygene kitchen aid molded of Beetle and Resinox. Impervious to rust and tarnish, it's made by Northern Industrial Chemical Co. for Progressive Novelty Industries Co. and is lightweight and washable

2 Dials for the new Cincinnati dial type milling machines consist of separate rings for each range of settings. Molded of clear Monsanto cellulose acetate they fit over black Durez bases. Buttons of red Bakelite phenolic thread into and conceal a recess at the top. All are molded by Recto Molded Products Co. and designed by J. E. Baxter

3 Connect this Handy Appliance plug to extension cords without tools. Ends of the two metal strands push through socket opening to either side of the center post. Separate disk, twisted into place, firmly locks wires in proper position. Molded of Resinox by Waterbury Button Co. for Albany Sales Company

4 A nifty job with flash bulb and all, the battery case of this Master Micromatic Speed Flash camera outfit is molded of Tenite II by Boonton Molding Co. for Kalart Co., Incorporated

5 Scrolled picture frame in the modern manner, designed by Ethel Hughes is fabricated from transparent Plexiglas sheet. Practically unbreakable the frame and picture are an integral decorative unit. Fabricated by Shoreham Mfg. Company

6 Designed to do the work of a myriad of plugs usually needed for grills, hot plates, percolators and the like, Cord Away appliance plug separates in the center to fit various units. Molded of black, heat-resistant Makalot

7 Complete with foot rail and brass cuspidor ash trays, this miniature old-fashioned bar holding three packs of cigarets is of mahogany Plastacele, molded by Plastics, Inc., for Mavco Sales Co. Also in pearl grey with nickel trim

8 Easy to read and completely indifferent to weather conditions Plastine house numbers are printed on Vinylite sheets and covered with a vinyl film. Fabricated by Sillcocks-Miller Company

9 Smooth in looks and action, this easy-to-clean egg slicer has a non-warping base made of either ivory Beetle, or red and green Resinox. Molded by Northern Industrial Chemical Co. for Progressive Novelty Industries Company

10 Light-weight outlet valve guards for use on gas masks are injection molded of Lumarith by Thermo Plastics Div., Standard Products Company

11 For home facials, the Belosan warm massage unit developed by Dr. Krauter consists of a molded Durez handle topped by a glass bulb. Handle openings admit hot water before the bulb is fitted tight. Molded by Marmont Plastics, Incorporated

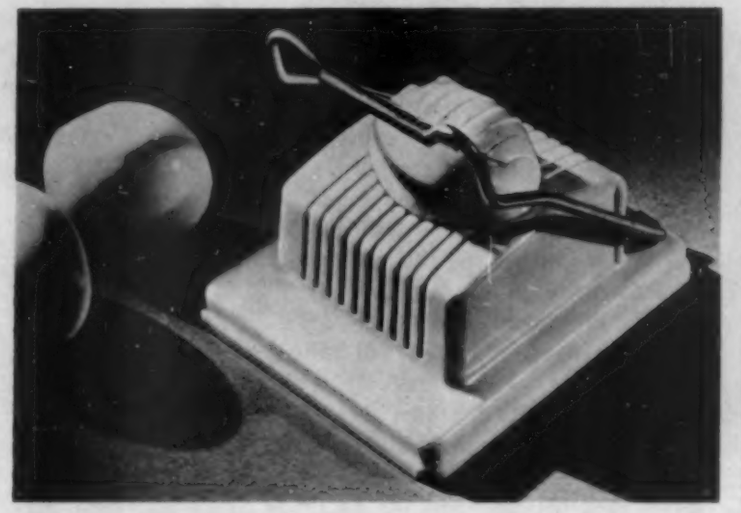
12 Pike-O-Scope, illuminated magnifier aids in examination of valve interiors and other machinery. Lamp cylinder and threaded ring of heavy, shock-resistant Bakelite phenolic molded by Boonton Molding Co. for E. W. Pike and Co. Defects can be seen at a distance of two feet from the eye

13 Prelude novelty vase made of Lucite has glass notes to hold flowers. Clef signs are of Plastacele. Manufactured by Universal Novelty Products for Norton Centerpieces

14 Paul Bry, designer, is responsible for this compact bar custom built for a private home. Surfaced with Formica, it resists alcohol stains and cigaret burns and is easily cleaned

For manufacturers' addresses write to the Editor, enclosing a self-addressed stamped envelope for reply.

9



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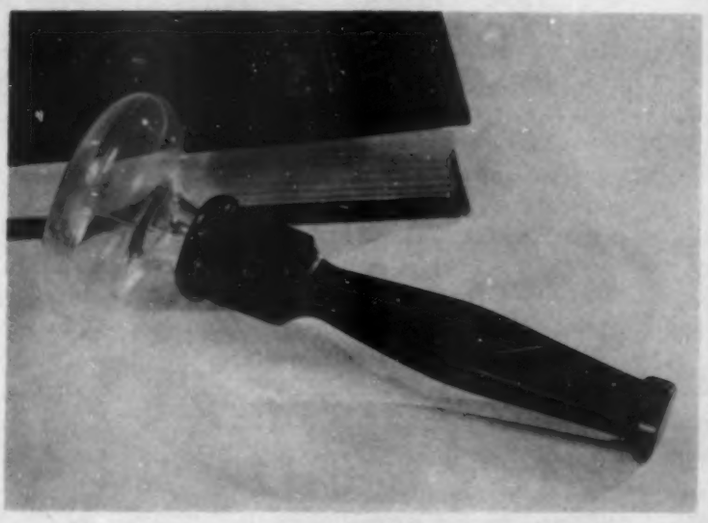

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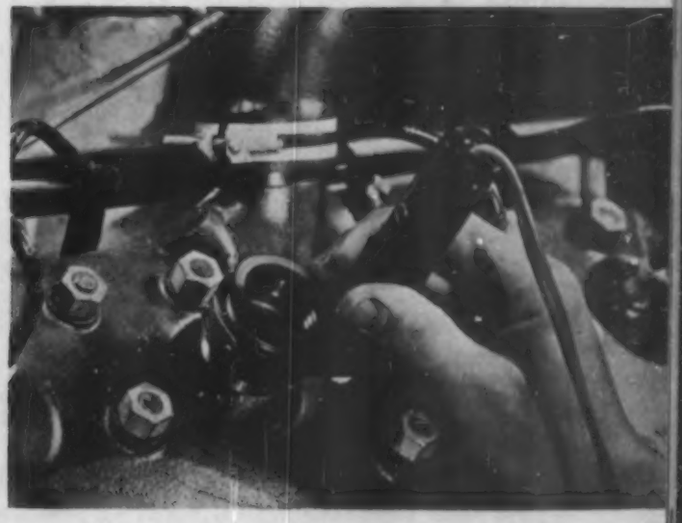

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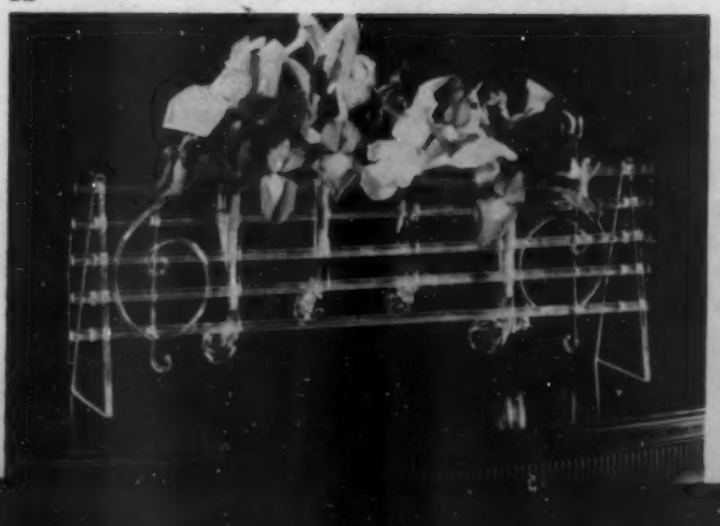


14

A Letter from London

THE tragic happenings of the last few weeks have naturally had serious repercussions on British industry and the plastics industry has not escaped. In particular, the invasion of Norway and the isolation and blockade of Sweden have cut off Britain's main supply of woodflour and paper pulp for use as fillers and bases for phenolics and urea resins. Fortunately the chief material manufacturers in Great Britain hold fairly healthy stocks of fillers, but in view of the greatly increased demand for plastics these stocks will have to be considerably augmented by large scale imports from Canada and the United States. During recent months some interest has been shown in the possibility of using home-produced ground sawdust from British mills, but this is not likely to meet with very much success because, in the first place, the sawdust is mixed and basically unsuitable, and, secondly, the quantity available is not substantial.

The demand by Government departments for all types of molded goods to replace those formerly made of metal and wood is becoming more intensive every week. These Government orders are, of course, in addition to those from industry generally which have increased several hundred percent. If war conditions continue it may be that some form of rationing not dissimilar to that introduced in Germany a few months ago will be necessary to insure that preference is given to vital Government work, and also to conserve supplies of synthetic resins.

The importance attached by the Government to the plastics industry is seen in the latest revised list of reserved occupations just announced by the Ministry of Labor. Men of 23 engaged in plastics and plastics goods manufacture are now relieved of the obligation to serve in the armed forces, it is reported; formerly, this age was much higher.

Naturally the relief afforded by the new revised list of occupations is much appreciated by manufacturers, but what would be still more welcome would be some form of legislation to prevent "labor snatching." Several cases have come to the notice of your correspondent during the last month. In one case a small molder with his own toolshop lost his chief mechanic, whom he had trained from a youth, to a new engineering firm just started up in the locality. The operative was promised and given a rise of 50 percent. In another case, a toolmaker lost two millers in one week to a neighboring engineering concern which offered double salary. The plastics industry is a relatively poor one and cannot compete with large engineering firms engaged on big Government contracts allowing a much higher margin of profit. It is known that some of these, especially the new companies who are desperately short of skilled labor, engage touts to scour the neighborhood for skilled workers to whom very considerable inducements are made to change their jobs. On the face of it this may seem merely a domestic problem of no particular interest to the American manufacturer, but, maybe, if war visits his Continent he may be faced with the same menace.

Office appliance manufacturers who are now building up their export trade are now turning to plastics and already one typewriter manufacturer is making use of phenol-formaldehyde molded parts instead of metal pressings. The redesigned machine will soon be on the market and it should prove of great interest as it represents the first important stage on the development of an all-plastic typewriter.

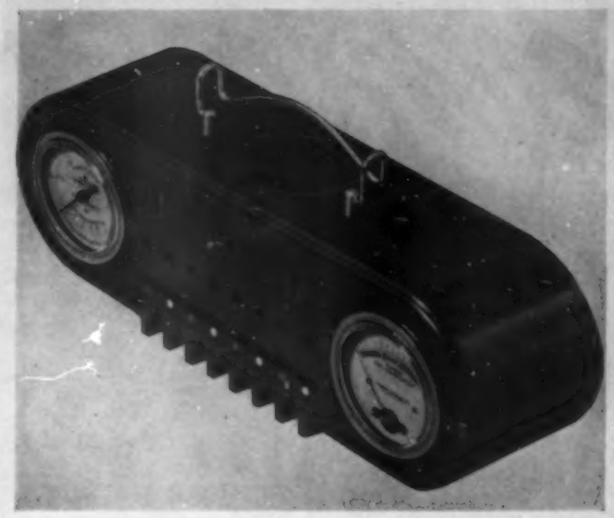
Shortage of tin and also its high price are factors responsible for some interesting plastic developments in the packaging field. One of the most significant is the substitution of a molded urea threaded head for the one previously made of non-ferrous metal. The molded head surmounted by a molded urea closure is used by Macleans for all tubes containing their peroxide dental paste.

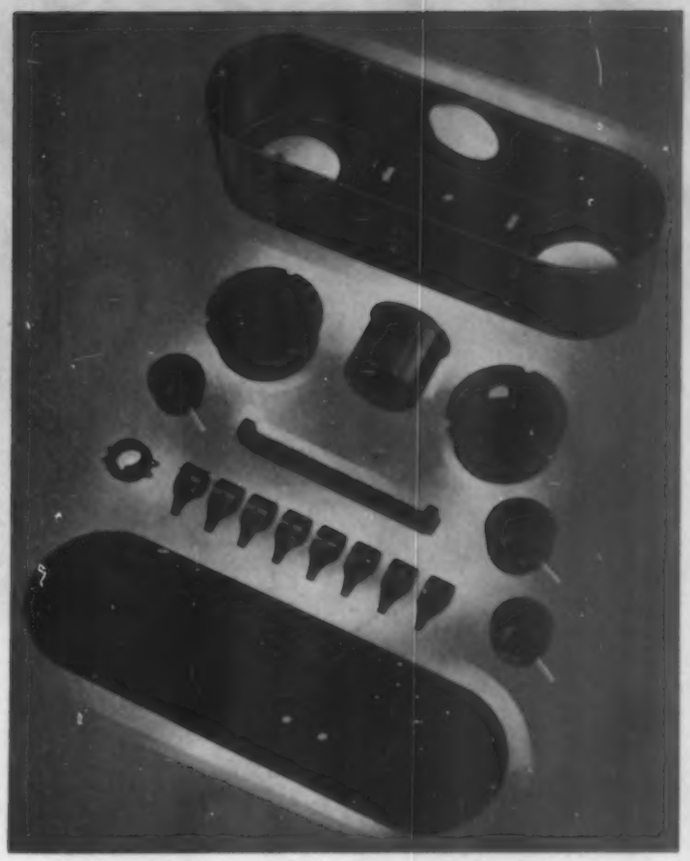
More interest is now being shown in the display field which has been as dead as mutton since the outbreak of war. It is realized that war or no war, people still want to buy things and as long as there are competitive lines of goods manufacturers will try to outdo one another in display. Owing to the scarcity of both wood and metal an increasing call is being made on the transparent plastics, particularly acetate and acrylic resin. Strangely enough, the latter is now obtainable at a price below that of acetate. The reason for this apparent anomaly is that there is a fairly large amount of reject material and off-cuts available from the aircraft industry and this is sold quite cheaply in comparison with normal prices.

John S. Nevin

May 11, 1940

Ed. Note—This is the third of a series of London Letters describing the effect of the European war on the British Plastics Industry. We quote the author's letter which accompanied his manuscript since it so vividly depicts the present atmosphere in Great Britain: "The way things are going leaves me no doubt that before long I shall be called to arms, maybe it won't be just yet, but I've got a hunch it will come sooner or later. I have to confess that a great feeling of restlessness comes over you and you feel that you want to be in the fight. It may mean 'Curtains' but the cause is worth it. Sorry to burden you with this dismal talk, but these are mighty anxious days for us. God knows, any minute a horde of Dorniers may swoop over London and drop their cargo of death and destruction. As I write this letter there is the steady drone of aircraft overhead, mostly Spitfires and Hurricanes and if the Boche does come he will get a very warm reception. . . However, we shall see what the future brings."





Economical production, light weight and efficiency are secured in the Warner Motor Analyzer (above) through molded plastics. Housing and cover are each produced in one operation and other parts, complete with metal inserts and decorations, come right from the molding press ready for rapid assembly. Imperial Molded Products Corp. molds 18 parts (right) of Bakelite phenolic. Clear Lucite is used also

Precision assembly—18 molded parts

FROM the tiny tell-tale observation windows to the smooth deep-drawn case, the Warner-Patterson Portable Motor Analyzer depends on plastics—accurately molded to close tolerances and tough in service—to satisfy cost, efficiency and construction requirements. A complicated mechanism for ascertaining motor vehicle engine performance, checking conditions of cylinder compression, vacuum, fuel handling, ignition and other phases of the electrical system, the complete analyzer is housed in a molded plastic case. Many of the operating parts themselves are plastic, even to the transparent panel inside.

In addition to automobile motor testing, the instrument is used in connection with grounding or cutting out half of the engine cylinders which are treated with a specially compounded solvent. The solvent container is placed in the compartment at the top of the motor analyzer, connections being made from it to the carburetor air-intake by a tube. The remaining cylinders are treated similarly. The small plastic windows above the 8 control switches are used for observing the spark condition at each spark plug.

Engineering requirements for the analyzer at the outset were sixfold—and stringent. The first demand was economical production. The market price of the product was such that manufacturing costs had to be kept at a minimum to make it salable. Secondly, simplified assembly to aid in keeping costs down. Lightness in weight was the third essential to lower shipping charges and to facilitate handling. For safety, electrical and heat insulation was needed. The possibilities of shock from the electrical wiring of the motor had to be eliminated and the ability of the product to withstand temperatures up to 200 deg. F. had to be assured. Finally, the product had to be immune to injury or loss efficiency caused by the various liquids with which it came into contact—gasoline, oil moisture, solvents, etc. The inherent chemical properties of phenolics plus their light weight, strength and ease of molding determined the selection of this material for the case and intricate parts.

In all there are 18 molded plastic parts in the assembly, all of which fit together and also fit the operating mechanism of the unit. (*Please turn to page 90*)

Color Harmony

Color for the home ...keynote of modern sales strategy!

Never before has tone harmony for home decorating been so much in demand by women . . . *and women dictate 90% of the purchases made for the household!*

These are important reasons why CRANE included the charm of color in its new heating units. CRANE'S contribution to convector enclosures is the removable grille made of molded Plaskon in rich shades of India Ivory, Citrus Yellow, Sun Tan, Pale Jade, Persian Red, and Black.

The CRANE use of Plaskon Molded Color as an effective sales promotion force typifies the versatility of this material—the *world's largest-selling urea-formaldehyde plastic.*

You will find that Plaskon Molded Color has many applications to your production and sales schedules. It has the advantage of being smooth and warm to the touch. Its hard surface won't chip, corrode, rust or tarnish. It won't stain, and ordinary washing keeps it brilliantly clean. People are attracted to Plaskon, and profits usually accrue from increased sales and manufacturing economies resulting from its use.

An experienced Plaskon representative will give you recommendations for adapting Plaskon Molded Color to your product development needs. Write or wire. No obligation!

2121 SYLVAN AVE. **PLASKON COMPANY** Incorporated TOLEDO, OHIO

Canadian Agent: Canadian Industries, Ltd., Montreal, P. Q.

for Crane Convector Enclosures

(Top)—CRANE grilles of Plaskon Molded Color are easily slipped into place, and are instantly removable for cleaning.

★

CRANE grilles of Plaskon Molded Color are supplied to the Crane Company, Chicago, Ill., by the American Insulator Corporation, New Freedom, Pa.

★

(Bottom)—The CRANE grille is one piece of Plaskon Molded Color, easily and quickly produced.

Trade Mark Registered

PLASKON

★ MOLDED COLOR ★

More about plastics patents

SINCE printing the story, "Looking at Patents on Molding" by Julian F. Smith (MODERN PLASTICS, April 1940) our attention has been called to an earlier patent which the inventor, Emil E. Novotny, feels should be presented in order that the development in the art and his pioneering position be brought to the attention of the molding public.

"This U. S. Patent No. 1,319,107," Mr. Novotny writes, "is of exceptional pioneering interest as it has now expired and the process is open to the public to use. It would not have been possible to mold such cylindrical and such curved printing plates by what I called 'brute force methods.' The writer at that time was working with lead and lead and tin faced matrices of a very fragile nature which were reproduced from monotype, with the exception of the halftones which were reproductions from copper, and the usual 'brute force' or compression molding methods would have destroyed the fragile matrices in the production of curved or cylindrical plates and, furthermore, it would not have been possible to obtain sufficient dimensional accuracy in a curved or cylindrical plate from the standpoint of uniformity of type high if compression molding methods had been used. It was therefore necessary to provide other molding methods and the injection method of molding was resorted to."

Copies of the patent, issued Oct. 21, 1919, and filed Dec. 18, 1916, may be obtained from the United States Patent Office at Washington, D. C.

Issued to Emil E. Novotny, of Riverside, Illinois, assignor to J. Stogdell Stokes, of Moorestown, New Jersey, the patent specification was abstracted from the printed copy as follows:

"This plate is preferably made of a plastic material, such as a phenolic condensation product and to produce the plate I set the shell *5* carrying the matrix into a suitable tubular casting box preferably of cylindrical form, which is indicated as an entirety by the letter *B*. In the present instance I have merely shown a sufficient portion of the casting box to give a complete understanding of the invention. Such casting box is preferably made of two duplicate semi-cylindrical sections, one of which is shown at *13*, each section comprising a bottom, *14*, a side wall, *15*, and a top wall, *16*, the latter removably mounted on the top end *17* of the side wall *15*, such top wall being preferably beveled downward and inward as shown at *18*. A ram or cover, *19*, is also provided which is beveled as at *20* to correspond to the beveled face *18* of the top wall of the casting box. Hinges *21* are provided to connect the two sections of the casting box, and of course when these two sections are closed to form a complete cylinder they may be latched together in any suitable manner. When the steel shell *5* carrying the matrix is placed in the casting box as is shown in Fig. 4 the ports or bores *7* in the flange *6* of the shell communicate with vertical channels *22* formed in the casting box, and similarly the vents *9* in the lower flange *8* of the shell *5* are intended to communicate with escape ports or channels *23* in the bottom of the casting box. The alinement or proper positioning of the steel shell with its matrix in the casting box may be insured in any suitable manner, such as by vertically grooving the wall of the casting box to seat or receive the overhanging edges of the clamps *12*, when the shell *5* is inserted in the box. After the shell and matrix have been positioned in the casting box as is shown in Fig. 4 the plastic plate-making material, which is also in the nature of a phenolic condensation product such as condensite or bakelite, in a soft sluggishly flowing condition is fed into the well or depression *24* formed in the top (*Please turn to page 92*)

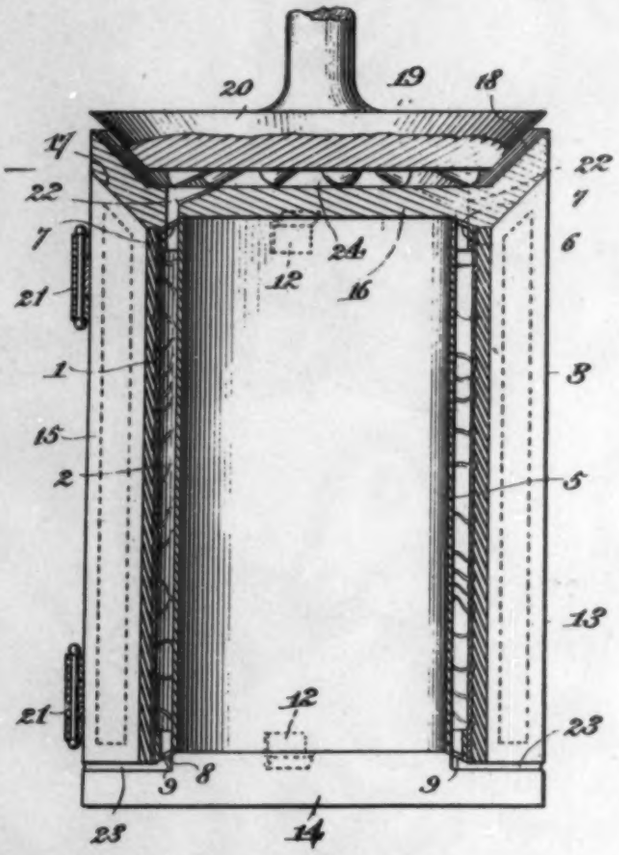
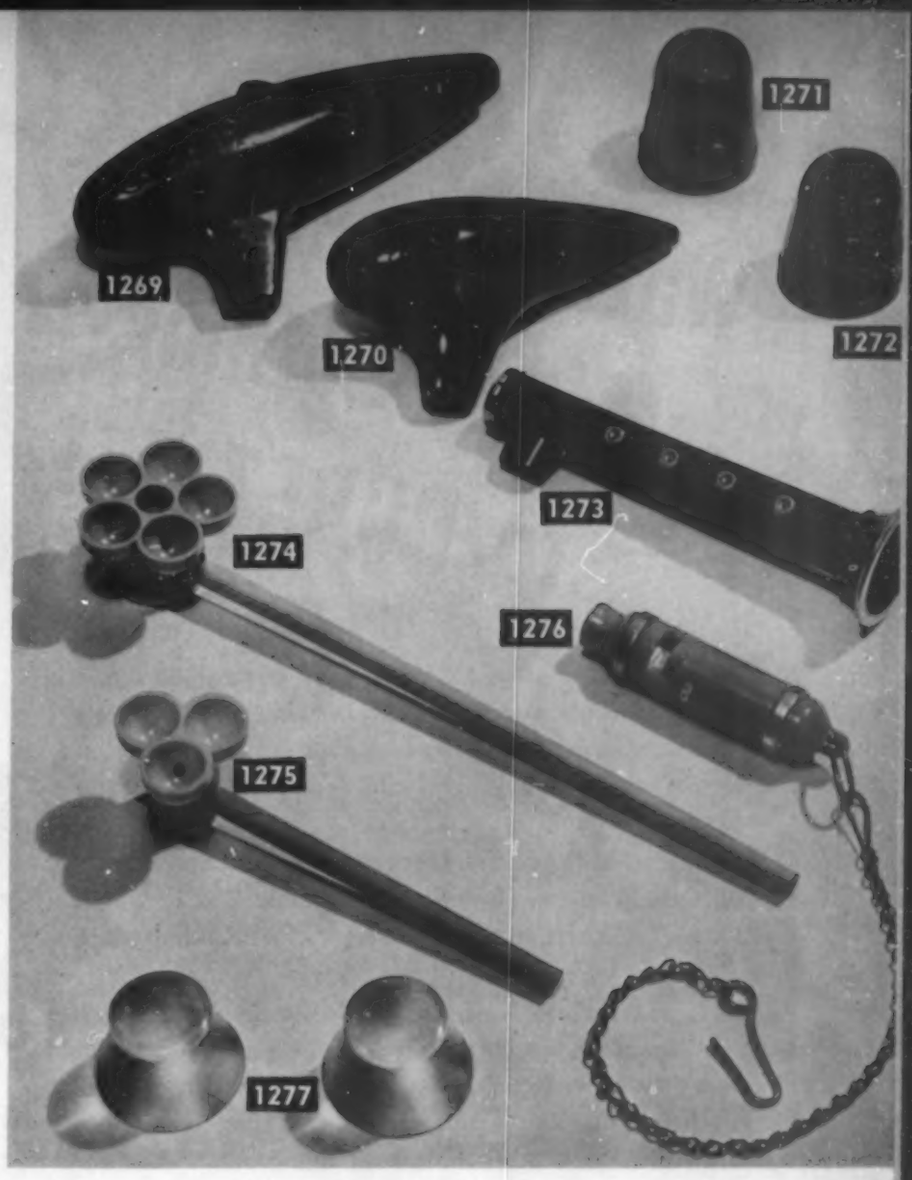


Fig. 4—Horizontal sectional view taken through a casting box and showing the casting of the cylindrical printing plate

All molders are invited to submit samples from stock molds to appear on this page as space permits. Address Stock Mold Department, Modern Plastics, Chanin Building, New York, for manufacturers' names and addresses

Reprints of Sheets One to Fifty-Two available in book form, twenty-five cents in coin or stamps



Stock Molds

SHEET NINETY-SEVEN

Bubble pipes, music makers, jigger caps and a magnifying glass, suitable for premiums or quantity sale, are available from stock molds without mold cost

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1269. Ocarina, overall length 6 in. Height from top of body to bottom of stem, 2 3/4 in. Molded plastic ocarinas assure accuracy and correct notes, uniform openings

1270. Ocarina, overall length 4 3/4 in. Height from top of body to bottom of stem 2 1/2 inches

1271. Jigger bottle cap, embossed design, top interior lined, threaded at top. Height 1 5/8 in. Diameter of top 1 in.; diameter of base 1 1/2 in. In deep red. Fits standard size bottles or cans

1272. Jigger bottle cap, embossed design, top interior lined, threaded at top. Height 1 5/8 in. Diameter of top 1 in.; diameter of base 1 1/2 in. In black

1273. Wazzoo, music maker. Overall length 5 1/4 in. With 4 nickeled stops. Metal rim at top

1274. Cluster bubble pipe. Five edge bowls, one center bowl. Overall length 9 in. Diameter of base 1 in. Diameter of top of bowl 1 3/4 in. Blows huge clusters of bubbles at one time. Hollow reed stem 7 3/4 in. long

1275. Bubble pipe, three bowls. Overall length 5 1/4 in. Diameter of base 3/4 in. Diameter of top of bowl 1 3/8 in. Hollow reed stem is 4 1/2 in. long

1276. Two-tone whistle. Overall length 3 1/4 in. Diameter through center 3/4 in. Metal parts nickel plated. Combined whistle and chain 14 1/2 in. long. Bright colors

1277. Jewelers' loupe, for tool makers too, with a magnifier top. Height 1 in. Diameter of magnifying surface 7/8 in. Diameter of base 1 7/16 inches

Water Torture Means Nothing to DUREZ 75!

Marine pumps have always suffered from electrolytic action which destroys the base, and attacks other vital parts. Phenolic plastics, being non-metallic, are immune to both corrosion and electrolytic action, and therefore seemed to offer a solution to this problem.

Experiments with plastics, however, showed that they, too, were definitely affected by continuous immersion in water. But Durez engineers, working closely with manufacturers, found the answer in Durez 75!

This has been the *only* plastic that is sufficiently water resistant to stand the gruelling test of bilge pump service. In addition to high moisture resistance and immunity to electrolytic action, this Durez plastic housing is tough enough to stand the hardest wear and tear of rigorous service. For further information about this Marine and other interesting applications of Durez 75 write—

NEW BILGE PUMP with completely molded housing of Durez 75 phenolic plastic, made by the Geo. W. Fleming Co., Plantsville, Conn. Of all plastics tried, Durez 75 was the only one able to meet the exacting requirements of rigorous marine service.

DUREZ PLASTICS & CHEMICALS, INC.
587 WALCK ROAD **NORTH TONAWANDA, N. Y.**

SERVICE STATION with walls of Durez resin-bonded plywood. This type of construction is said to save up to $1000 per station, yet gives great flexibility of design with structural strength and excellent insulating qualities.

ALUMINUM PAINT for city truck fleet maintenance comes in for a lot of hard use and abuse. It must show great wear and weather resistance over long periods of time . . . and it *does* when formulated with Durez resins!

DUREZ OIL SOLUBLE RESINS produce splendid gloss overprint varnishes and litho finishes for metal signs. These finishes have excellent color retention and look fresh after long weather exposure.

DUREZ PLASTICS & CHEMICALS, INC.

RESINS THAT FIT THE JOB

Technical Section

History of plastics and their uses in the automotive industry

by GORDON M. KLINE*

THE year 1939 marked the 70th anniversary of the issuance of the first United States patent describing one of the many varieties of compositions generally known today by the name *plastics*. Forty years elapsed before there appeared the first of the synthetic resin patents which were to mark the seemingly unlimited diversification of the products of this industry. During this period of the development of the modern plastics industry, the automobile and airplane were likewise passing through their caterpillar stages toward the streamlined, colorful versions of today. The aircraft and motor car industries were destined to consume a large percentage of the annual production of these new synthetic products and the present outlook gives promise of even more important applications in this direction. It is in recognition of this latter situation that this paper on plastics has been scheduled for this annual meeting of automotive and aircraft engineers.**

The subject of plastics has been discussed from many angles in review papers before engineering and scientific societies in this country. Some have been concerned primarily with the chemistry[1] of these materials and others with their physical properties.[2] Some have dealt with them purely from the standpoint of fabrication[3] and still others have considered their uses in various industries.[4] In response to an invitation to review developments in plastics for your annual meeting, a new approach to this subject was sought. It was finally decided to present to you a chronological survey of the development of plastics in this country, outlining the special properties which characterized each new material and which in many instances were there by design and not by mere chance alone. The important uses which have been made of these various plastics in the automobile and airplane will be recounted.

* National Bureau of Standards.

** Presented before the Passenger Car Body Session at the Annual Meeting of the Society of Automotive Engineers on Jan. 17, 1940.

DR. GORDON M. KLINE

Cellulose nitrate plastic

The oldest of the synthetic plastics is the cellulose nitrate or pyroxylin type. It is amazing that a material so hazardous to handle, so readily decomposed by heat and so unstable to sunlight in the unpigmented form has held an important share of the plastics business for so many years. However, it has many unique properties which until recently have made it the best available thermoplastic material for many purposes. Newer thermoplastics have in the last five years sur-

1. Symposium on The Phenomena of Polymerization and Condensation, presented before the Faraday Society; Trans. Faraday Soc., *32*, Pt. 1, 1–412 (1936).

The Classification and Chemical Genetics of Organic Plastics, by G. M. Kline, presented before the Electrochemical Society; Trans. Electrochem. Soc., *74*, 23–45 (1938); MODERN PLASTICS, *16*, No. 10, 46, No. 11, 52, No. 12, 48 (June, July, Aug., 1939).

2. Symposium on Plastics, presented in 1938 before the American Society for Testing Materials; available in booklet form from the A.S.T.M.

Fundamental Characteristics of Moldable Plastics, by Gordon Brown; presented before the Washington Section of the Society of Automotive Engineers; S.A.E. Journal, 45, 9–12 (Oct. 1939).

3. Developments in Plastics—Molding Equipment, by Louis F. Rahm, presented before the American Society of Mechanical Engineers; Mech. Eng., *60*, 117–22 (Feb. 1938).

Design Problems of Molded Plastics Parts, by D. M. Buchanan, presented before the American Society of Mechanical Engineers; Mech. Eng., *59*, 907–13 (Dec. 1937).

4. Symposium on Plastics and Dielectrics, presented before the Electrochemical Society; Trans. Electrochem. Soc., *74*, 23–210 (1938).

Plastics—Some Applications and Methods of Testing, by T. Smith Taylor, presented before the American Society for Testing Materials; Proc. Am. Soc. Testing Mat., *37*, Pt. 2, 5–21 (1937).

Plastics Materials, by Harry Burrell, presented before the American Society of Mechanical Engineers; Mech. Eng., *59*, 917–22 (Dec. 1937).

Plastics as Structural Materials for Aircraft, by G. M. Kline, presented before the Institute of the Aeronautical Sciences; *J. Aero. Sciences*, *5*, 391–6 (Aug. 1938); MODERN PLASTICS, *15*, No. 12, 35 (Aug. 1938); *16*, No. 1, 44, (Sept. 1938).

1

2

3

1—The earliest factories of the Celluloid Corp. back in 1873 when horse and buggy held sway. 2—A transparent Celluloid storm front in the 1905 single cylinder, 7 hp. motor Oldsmobile runabout represents the first appearance of plastics in the automobile. 3—A corner of Dr. Leo Baekeland's laboratory at Yonkers, N.Y. Built against the wall is a simple wooden work bench. Reflux condenser and experimental "kettle" may be seen at left

passed the cellulose nitrate type in volume of production, but it is significant that the pyroxylin plastic production figures increased steadily from 1932 to 1937 and were about 41 percent higher in 1939 than they were in 1938.

The discovery and preparation of cellulose nitrate itself can be traced back to the early work of Braconnot in France in 1833 and that of Schoenbein in Germany in 1845. Parkes, an Englishman, prepared various articles from a solution of cellulose nitrate and camphor during the period 1855 to 1865, but John Wesley Hyatt, an American, is generally credited with being the first to attempt to work with cellulose nitrate as a plastic mass rather than in solution. Hyatt with his brother, Isaiah S. Hyatt, took out a patent[5] in 1869 for making solid collodion with very small quantities of solvent, dissolving the pyroxylin under pressure, thus securing great economy of solvents and a saving of time. Improvements in the process of mixing the pyroxylin and camphor were noted in patents issued in 1870[6] and 1872[7] to the Hyatts. The Albany Dental Plate Co. was organized in 1870 to handle the first application of the cellulose-nitrate-camphor plastic, but by Jan. 28, 1871, the demand for the material for miscellaneous uses had become sufficiently great to bring about the formation of the Celluloid Manufacturing Co. which moved from Albany to Newark, its present location, in 1872. Today *Celluloid* is only one of a number of trade names used to designate cellulose nitrate plastics produced by various firms in this country.

Cellulose nitrate plastic was one of the first to be used in the automobile, being employed in sheet form as windows in the side-curtains of early models. Its flexibility and non-fragility were important factors in this application, but its susceptibility in the transparent form to ultraviolet light resulted in rapid deterioration of these sheets. Later in the development of the motor car, cellulose nitrate plastic served as the bonding material for the manufacture of laminated glass, but it was soon superseded for this use by more light-stable transparent plastics. Cellulose nitrate itself has been widely employed as pigmented lacquer to provide a protective and colorful coating for the metal body.

Cellulose nitrate plastic is available in a wide range of decorative effects and possesses many versatile working qualities. By means of dyes and pigments which can be incorporated in the plastic mass by kneading, filtering, rolling, pressing, sheeting, restacking, and resheeting, a wide variety of distinctive transparent and opaque colors and mottled variegated effects can be produced. It is readily formed into hollow articles by applying air or liquid pressure between heated sheets and blowing or expanding them to the shape of the retaining mold. This material can be utilized in the veneering of many articles by either stretching the plastic while hot, cooling so as to retain stresses in the plastic, and then releasing the strains by reheating which tends to restore the plastic to its original form, or by swelling the plastic in certain organic liquids whose absorption makes it pliable without dissolving it. Upon evaporation of the swelling liquid, the plastic shrinks tightly over the covered object. Pyroxylin plastic is also readily cemented to itself and to other

5. U. S. P. 91,341.
6. U. S. P. 105,338.
7. U. S. P. 133,229.

materials, which is advantageous in the fabrication and assembly of many articles. Despite these extraordinary working qualities, cellulose nitrate plastic is not well adapted to compression molding, because its thermoplasticity makes necessary chilling of the mold before removal of the molded article, and it cannot be used in injection molding presses because of its sensitivity to high temperatures. In addition, a fundamental reason for the failure of cellulose nitrate plastic as a molding compound in powder form is the difficulty of welding together by the application of heat and pressure discrete particles of cellulose nitrate plastic containing the usual proportion of plasticizer. If fragments of ordinary cellulose nitrate plastic are subjected to heat and pressure in a mold, they are compressed into what appears to be a sound and homogeneous molded article, but this article can readily be broken down into the fragments from which it was formed; there is no strong weld between particles as in cellulose acetate molded parts. A firm weld and a truly continuous molded article are obtainable only if the proportion of plasticizer to cellulose nitrate is increased to such a concentration that the mass is soft and useless for practical purposes.

The contributions of this first synthetic plastic to the plastics industry have been extensive and lasting. It not only paved the way for the advances which have been made in the formulation and pigmentation of all thermoplastics, but it also supplied much of the mechanical and operative means of manufacture and fabrication. It was the real pioneer in the development of the market for plastics and in many of their uses.

Summary of information regarding cellulose nitrate plastic:

Outstanding properties: Colorability, ease of cementing, ease of fabrication, flammability, flexibility, thermoplasticity, transparency, toughness, water resistance.

Forms available: Sheets (20 in. by 50 in. standard size), rods, tubes, color chips, lacquers, emulsions.

Methods of fabrication: Molding by heating at 160 deg. to 220 deg. F. and pressing, blowing by placing softened sheets of the material in a mold and forcing air between them, cutting, sawing, punching, drilling, drawing, turning, printing, embossing, polishing.

Typical applications: Bag frames, brushes, buckles, clock dials and crystals, cutlery handles, drafting instruments, fountain pens, piano keys, shoe eyelets and lace tips, spectacle frames, toilet seats, tool handles, toothbrush handles, toys, wooden heel covers.

Trade names and manufacturers:

Celluloid—Celluloid Corp., Newark, N. J.

Monsanto C.N.—Monsanto Chemical Co., Plastics Div., Springfield, Mass.

Nixonoid—Nixon Nitration Works, Nixon, N. J.

Pyralin—E. I. du Pont de Nemours and Co., Inc., Plastics Dept., Arlington N. J.

Shellac plastic

The next plastic to become of importance in this country was shellac molding composition. Shellac is of natural origin being produced by an insect which lives upon certain trees in India and Southern Asia, and has been known and utilized for many centuries for various purposes, such as a component of sealing waxes, polishes, and varnishes. Some of the patents relating to its use in molding compositions are contemporary with Hyatt's discovery of pyroxylin plastic, for example, one to Merrick[8] in 1868 and another to Gardner[9] in the same year. However, the first application of any magnitude for shellac molding composition dates from its use by Emil Berliner in 1895 for phonograph records. In 1888 he had worked out the details of the method that made it possible to engrave a sound groove on a flat disk, but means of duplicating these recordings remained to be perfected in order to make them available in large numbers, obviously a problem in plastics. He tried both cellulose nitrate and hard rubber, but neither of these materials was satisfactory for his purpose. In 1895 he turned to plastic composition containing shellac as a binder and soon the technique of molding shellac base phonograph records was under full development. It remains today the largest single outlet for shellac in the plastic molding field.

8. U. S. P. 85,018.
9. U. S. P. 73,088.

Please turn to next page

4—Distributor caps from numerous makes of cars are molded from phenolic compounds as are the rotor arms, spark plug hoods, switch parts and other accessories, as in 5. (Photos, courtesy Dures Plastics & Chemicals Co., Inc.)

4

5

6

7

6—The Bakelite controller plate (left) from a mold made about 1909 (and still used occasionally) by S. S. White Dental Mfg. Co. Right—In 1916 a mold produced this improved plate. 7—Laminated Textolite gears by General Electric Co.—the large one is for an automobile timing mechanism

It was first used extensively for molded electrical insulation about 1900 and is at present especially employed for the manufacture of very high voltage insulators. It was used in the ignition systems of motor cars during the period 1900 to 1910, but its low softening point and tendency to distortion have caused it to be replaced as an insulating material to be used under the hood by thermosetting resin compositions which can be relied upon for all year service. Developments for the past twenty years have been primarily in its application as a resinous binder for cloth, paper, silk, mica and other insulating components, and it is only in such electrical insulation that shellac is employed in the automobile today.

The properties which make it especially suitable for the manufacture of records are easy moldability, toughness, hardness, fidelity of reproduction, low cost and possibility of re-using the scrap material. Its oilproofness and excellent insulating qualities are responsible for its employment for many electrical parts. Shellac has good resistance to arcing or tracking over by an electric current, and insulators that have been short-circuited usually remain good insulators because of the absence of any tracking. It is also one of a number of resins which exhibit characteristics of both the thermoplastic and thermosetting types of binders. However, the long period required to develop the cured condition limits the utilization of this thermal-hardening property to such products as paper cylinders, which can be heated for several hours at an elevated temperature to develop the maximum mechanical and electrical strength of the binder.

Summary of information regarding shellac plastic:

Outstanding properties: Ability to wet fibers, adhesion, arcing resistance, ease of molding, hardness, high gloss, high dielectric strength, low dielectric constant, oil resistance when cured, resilience.

Forms available: Shellac flakes, buttons, and slabs, alcoholic varnishes, alkaline aqueous emulsions.

Methods of fabrication: Shellac molding compositions are softened upon a steam table and molded at 250 deg. to 275 deg. F. under 1000 to 3500 lbs. per sq. in., chilling the mold to about 100 deg. F. before releasing the pressure. Injection molding is also feasible.

Typical applications: Adhesives, dental blanks for taking impressions, electrical insulation, grinding wheels, novelties, phonograph records, poker chips, protective coatings, thermal insulating board.

Trade names and manufacturers:

Compo-Site—Compo-Site, Inc., Newark, N. J.
Electrose—Insulation Manufacturing Co., Brooklyn, N. Y.
Harvite—Siemon Co., Bridgeport, Conn.
Lacanite—Consolidated Molded Products Corp., Scranton, Pa.
....—T. F. Butterfield, Inc., Naugatuck, Conn.
....—Waterbury Button Co., Waterbury, Conn.

Bitumen plastic

The third plastic material to become industrially important in this country was the bituminous type, more commonly known as *cold molded*. Emile Hemming was the pioneer in its development in the United States and introduced it on the market in 1909. He notes in his book on *Plastics and Molded Electrical Insulation*, which was published in 1923, that his purpose was "to produce a commercial heat-resisting molded insulating product for extensive use, particularly in the electrical, the wiring device, and the automotive fields." At that time, 14 years after its inception, its output considerably exceeded that of its contemporary, the hot-molded phenol-formaldehyde resin. However, in 1938 Hemming wrote that "the production of cold molding materials in this country today is probably not more than 25 percent of its volume ten years ago. The one remaining advantage of cold molding materials and parts over other materials and their products in the plastics field today is heat resistance. If and when phenolics or other synthetic resins are compounded with equal heat resistance through elimination of wood flour and increased percentages of asbestos, even this advantage will disappear."

The raw materials used in the preparation of cold-molded plastics are asbestos, asphalts, coal tar, stearin pitches, natural and synthetic resins, and oils. The asbestos in the proportion of 70 to 80 percent contributes the body of the material and the bituminous or resinous ingredients in the proportion of 20 to 30 percent function as the binder. Because of the presence of volatile solvents and drying oils in the composition, the conditioning and storage of the plastic prior to molding require close attention. This has resulted in the preparation and molding of the material being carried on in the same plant instead of its sale to custom molders. The molding is done at or near room temperature, usually in a single cavity mold, and the pieces after removal from the mold are cured in electrically heated ovens to drive off the volatile constituents, oxidize or polymerize the oils or resins, and so transform the plastic into a hard, infusible state. The length of cure depends upon the size and shape of the part but, in general, the curing time varies from 24 to 72 hours with temperatures ranging in gradual steps from 125 deg. to 425 deg. F. The shrinkage which occurs during this baking operation prevents the maintenance of very close tolerances on cold-molded parts. The cold-molding operation is faster than hot compression molding since the curing is not done in the mold, but the higher pressures required for cold molding and greater abrasive action of the mineral filler make mold maintenance much more of a problem than it is in hot molding. Battery boxes remain the one important use of bituminous plastics in the automotive field.

Summary of information regarding bitumen plastic:

Outstanding properties: Heat resistance, lower cost, rapid molding cycle, dimensional tolerances must be greater than for hot-molded compositions.

Forms available: Only as finished articles.

Methods of fabrication: Molded under pressure in cold molds and cured by heating in ovens.

Typical applications: Connector plugs on household electrical equipment, handles and knobs for cooking utensils, valve wheels, arc shields, and battery boxes.

Trade names and manufacturers:

Aico—American Insulator Corp., New Freedom, Pa.
Cetec—General Electric Co., Plastics Dept., Pittsfield, Mass.
Ebrok—Richardson Co., Chicago, Ill.
Gummon—Garfield Mfg. Co., Garfield, N. J.
Okon—American Hard Rubber Co., New York, N. Y.
Thermoplax—Cutler-Hammer, Inc., Milwaukee, Wis.

Phenol-formaldehyde resin

The first and still the most versatile of the commercial synthetic resins, the phenol-formaldehyde condensation product, was described and patented in 1909 in this country. Thus, both the original thermoplastic material, cellulose nitrate plastic, and the original thermosetting material, phenol-formaldehyde resin, were discovered and developed in the United States, but surprisingly enough practically all the later cellulose and synthetic resinous plastics were brought to this country after successful production abroad.

Baeyer in 1872 reported that the reaction between phenols and aldehydes leads to the formation of resins, but no products of industrial interest were obtained for the next 35 years because of the inability of investigators to control the reaction. In 1909 Baekeland received the so-called *fifth-mol* patent,[10] in which it was indicated that a heat-hardenable resin could be produced by using an alkaline catalyst to the extent of 0.5 to 10 percent (equivalent to not more than 0.2 mol per mol of phenol), and in no case above 20 percent of the total reaction mixture. The *heat and pressure* patent,[11] provided the technique for converting this resin in a relatively short time into a molded article of excellent mechanical and electrical properties. The basic patents covering the preparation of solutions of this resin[12] and their use in impregnating fibrous sheets to make laminated products[13] were issued to Baekeland in 1910 and 1912, respectively.

The manufacture of *Bakelite* was begun in Dr. Baekeland's Yonkers laboratory in 1907. The General Bakelite Co. was organized in 1910 and was merged in 1922 with the Condensite Co. and the Redmanol Chemical Products Co. into the Bakelite Corporation. Since the expiration of the basic patent in 1926, many other firms have marketed phenolic resins under various trade names. An important modification of this general type of resin is the use of furfural in place of formaldehyde for the condensation reaction with phenol. Patents for the preparation of phenolic resins of this type were issued to E. E. Novotny and others, involving both acidic[14] and basic [15] catalysts and no catalysts, and their manufacture has been carried on by Durite Plastics, Inc., since 1922.

The most general application of phenolic plastics in automotive vehicles is in parts of the electric system where a good dielectric is required, as in distributor heads, coil parts, switches, and related elements. These accurately dimensioned, interchangeable molded parts of the ignition system, which remain undistorted under the heat of the adjacent engine, have played an important part in contributing to the trouble-free service characteristic of the modern automobile. Chief among the purely mechanical applications of phenol resinoids in the motor car is that of the cam shaft gear of canvas-laminated resinoid, used to silence the operation of the timing train. An increasing amount of phenolic resins is entering into the composition of materials for impregnation of brake linings, with the advantages that accrue from substituting infusible resins for fusible materials. The automotive industry also makes use of phenolic-resin-bonded grinding wheels which, because of their (*Please turn to page 84*)

10. U. S. P. 942,809.
11. U. S. P. 942,699.
12. U. S. P. 954,666.
13. U. S. P. 1,019,406.
14. U. S. P. 1,398,142-9; Nov. 22, 1921.
15. U. S. P. 1,705,493-6; Mar. 19, 1929.

Pictured in operation at the left is a plastic extrusion machine processing single strip continuous length rod. Forced from the die by enormous pressure, the plastic is being discharged at a constant rate from the orifice of the jacketed head. It is then carried down the conveyor for cooling and subsequently may be cut to lengths or wound on coils

Extrusion of plastics

by DONALD L. GIBB*

EXTRUSION, a process which seems to have caught the imagination of plastics fabricators almost over night, is not new, and it is surprising that a method of fabrication, which is so well adapted to volume production, should have been neglected so long. The fundamental principles of extrusion are relatively simple. A thermoplastic material is plastified, or softened, by heat, forced through a shaping die and allowed to cool. This process often has been likened to injection molding, which is sometimes termed "*extrusion molding.*" While both operations do have points of similarity, they differ widely in two fundamental respects: (1) In contrast to extruded shapes, injection molded parts need not be uniform in cross section throughout their length; (2) in injection molding the heat-softened plastic accepts almost the exact shape of the mold *into* which it is forced, while in extrusion the plastic takes approximately the shape of the die through which it passes.

*Research Engineer, Cellulose Products Div., The Dow Chemical Co.

Extrusion machines

Extrusion is commonly effected by either the positive pressure piston type machine or the screw type. The latter is in more general use in this country, and its operation is the subject of this discussion.

Essentially, the screw type extrusion machine consists of a horizontal tube which contains a closely fitted screw of constantly diminishing pitch. This tube is jacketed to provide for the circulation of a heating medium. An opening through the top of the tube and jacket, at the drive or low pitch end of the screw, pro-

vides a point for feeding the plastic material into the screw. At the discharge end of the tube and screw is a jacketed head capable of withstanding the enormous pressure developed in this section, and in the center of the head, in the case of single strip extrusion, is the die itself. In some cases a strainer is placed between the screw and the die. It is the function of the machine to heat and knead the plastic to a uniform plasticity, and then to force it through the die at a constant rate. Once the *uniformity* of heat plastifying and *constant rate* of extrusion are accomplished successfully, two major problems in this method of fabrication are solved.

The ideally designed extrusion machine is completely streamlined, providing no shoulders, pockets or joints in which the plastic may lodge and become overheated, or make cleaning difficult. For this reason, a machine with a strainer may not be well suited for use with a particularly heat-sensitive plastic. The inventory in the head (beyond the tube in which the plastic is continuously kneaded and kept in motion) should be as small as possible in order to prevent overheating. In short, the entire assembly of such a machine should be designed to achieve quick and thorough heat plastifying without overheating, and to expedite the passage of the softened plastic material through the die with a minimum of delay.

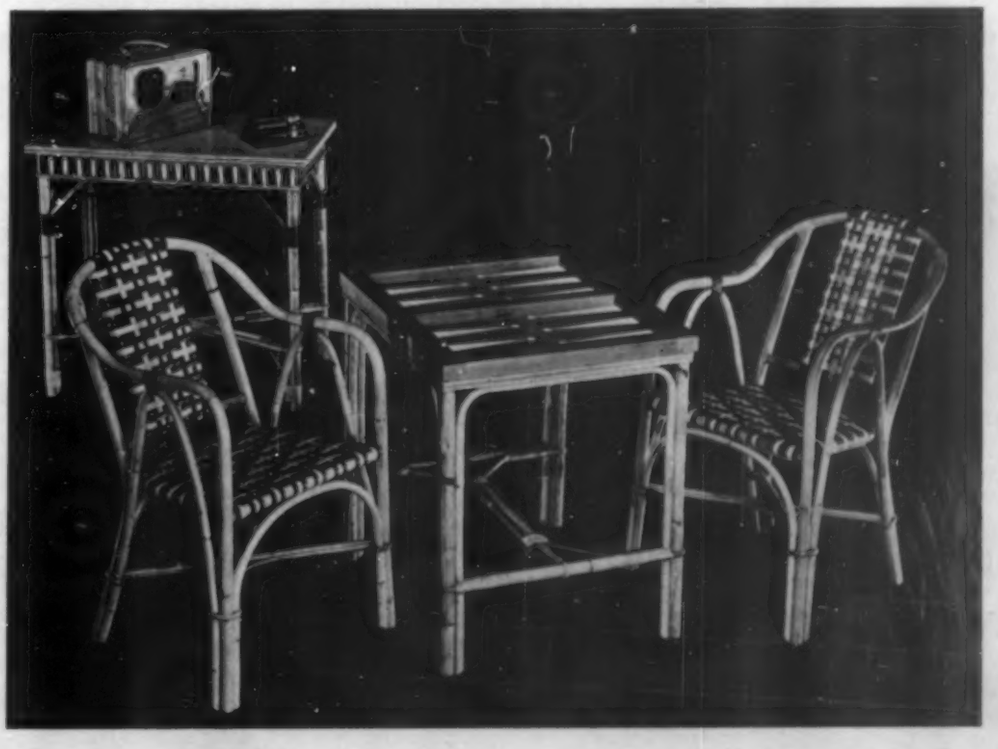
For those plastics which soften at the lower temperatures, steam is frequently employed to heat the die, head and cylinder. By regulation of the steam pressure, accurate temperature control can be obtained. For high temperatures at low pressures, a Dowtherm system provides an ideal heat source. Still another widely used heat transfer agent is circulated oil. Heated electrically and thermostatically controlled.

The die

The design of the die is regulated, to a certain extent, by the type of plastic to be extruded, as well as the size and shape of the part to be made. However, it is seldom necessary to design long dies. Upon leaving the die, the plastic form is usually stretched to a greater or lesser extent, so the size of the opening is generally larger than the corresponding dimension of the extruded and stretched part. This is particularly true if the passage through the die is long. The shape of the extruded part, in some cases, differs materially from that of the die opening, so that when a given shape is desired, this change must be considered in the design of the die. Fortunately, extrusion dies are relatively inexpensive, and experimentation may be conducted on a much less costly scale than is possible in the case of injection, or conventional, molding practice.

The take-off

The extruded material as it issues from the die is soft and easily deformed. Hence, provision must be made for its reception, removal and cooling at a controlled speed and in such a manner that deformation may be avoided. For simple shapes, a moving belt is a suitable take-off and cooler. Special handling methods, however, are required for more intricate and more delicate shapes. The design and operation of the take-off is especially important in the case of plastics which must be heated to a high temperature to develop gloss and good physical properties. Such plastics are extruded in a very soft condition, and as a consequence do not readily retain the die shape. It is important, therefore, to consider the properties and possible reactions of the plastic material to be used (*Please turn to page 88*)



Brightly colored, weather - resistant extruded Ethocel strips are woven into sturdy comfortable porch furniture. Fabricated by Pierce Plastics for Ficks Reed Company

Plastics statistics for the U. S.

THE United States Tariff Commission's preliminary statistics of United States production and sales of synthetic organic chemicals in 1939 reveal that sales of all synthetic organic chemicals in 1939 not only exceeded by 38 percent those in 1938, a year of poor chemical sales, but also *exceeded those in any preceding year*. The increase in coal-tar chemicals was 41 percent, or from $130,462,000 in 1938 to $183,355,000 in 1939, and in non-coal-tar synthetic organic chemicals 36 percent, or from $146,435,000 in 1938 to $198,562,000 in 1939. The groups that advanced the most in sales value were intermediates, medicinals, and synthetic resins. This peak activity in synthetic organic chemicals in 1939 resulted from improved business conditions, a building up of inventories by both producers and consumers, and increased exports in the last quarter, particularly to countries whose imports of synthetic chemicals previously came chiefly from the European belligerents.

The total production of synthetic resins in 1939 was considerably *more than in any preceding year*. The complete data for 1939 and the comparative totals for 1938 and 1937 are given in Table 1. The 179,338,000 pounds of resins of coal-tar origin manufactured exceeded by 67 percent the output in 1938. Alkyd resins were up 87 percent and tar acid resins 58 percent. The output of 33,690,000 pounds of non-coal-tar resins in 1939 was 44 percent more than in 1938. The rapid expansion in the use of urea resins for surface coatings resulted in an increase in their production of more than 100 percent. An increase of several fold in sales of the high-priced vinyl acetal resins, for safety glass manufacture, resulted in a change in the average unit value of sales of non-coal-tar resins from $0.41 in 1938 to $0.46 in 1939. The average value per pound of urea resins decreased from $0.44 to $0.36 during the year.

The output of miscellaneous non-coal-tar synthetic organic chemicals in 1939 was 2,946,151,000 pounds, or 24 percent more than in 1938. Plasticizers of coal-tar origin and those not derived from coal tar were reported separately as subgroups for the first time. The statistics on the production and sales of plasticizers during 1939 are presented in Table 2.

Statistics of the Bureau of the Census for the production of cellulose plastics during 1939 are recorded in Table 3. These figures also reveal that 1939 represented an *all-time high* for reported cellulose plastics production, although it may be assumed that the production of cellulose acetate molding composition in 1937 was sufficient to make the total figure for the production of cellulose plastics in that year approximately equal to or slightly greater than the 1939 total. A total of 34,169,007 pounds of cellulose nitrate and cellulose acetate plastics were produced in 1939, compared with a previously reported high total of 33,914,377 pounds of cellulose nitrate in 1919. Cellulose acetate plastic was

Table 1.—United States production and sales of certain synthetic resins, 1939

Differences between the quantities of production and sales are due primarily to consumption by producing concerns.

	Production	Sales		
	Pounds	Pounds	Value	Unit Value
(A) Coal-tar: Total	179,337,857	128,419,871	$23,028,083	$0.18
Alkyd resins:				
Maleic anhydride	6,263,542	4,929,403	925,048	.19
Phthalic anhydride	70,208,098	33,161,064	6,925,898	.21
Derived from tar acids:				
Cresols or cresylic acid	10,515,557	7,893,863	1,063,772	.13
Phenol:				
For casting	8,517,368	8,252,263	3,152,444	.38
For molding	19,421,778	17,396,556	2,571,930	.15
For other uses	27,785,891	25,766,207	3,738,052	.14
Xylenols	442,899			
(B) Non-coal-tar: Total	33,689,691	34,876,766	15,983,403	.46
Urea	16,569,343	14,556,232	5,288,767	.36
Total for resins 1939	213,027,548	163,296,637	39,011,486	.24
Total for resins reported[1] 1938	130,358,652	101,828,188	22,871,974	.22
Total for resins reported[1] 1937	162,104,713	127,175,452	25,845,164	.20

[1] Does not include resins from adipic acid, coumarone and indene, hydrocarbons, styrene, succinic acid, and sulfonamides.

not introduced on the market in the United States until 1927. Addition of the figures for the production of ethylcellulose and cellulose acetate butyrate plastics during 1939 to the above total would increase considerably the margin by which the 1939 production exceeded the previous high.

Examination of the figures for cellulose nitrate and cellulose acetate indicates that the latter is continuing to forge ahead of its competitor. The production of cellulose nitrate plastic was up 41 percent in 1939 compared with 1938, whereas cellulose acetate plastic production increased 46 percent with the great bulk of this increase being attributable to a 58 percent increase in the manufacture of molding composition.

Comparative data for the production of synthetic resins and cellulose plastics in the United States for the years prior to 1937 will be found in MODERN PLASTICS for October 1937, page 6, and October 1938, page 11.

Table 2.—United States production and sales of plasticizers, 1939

	Production Pounds	Sales		
		Pounds	Value	Unit Value
(A) Coal-tar:				
Plasticizers: Total	23,839,211	19,299,337	$4,089,378	$0.21
Phthalates: Total	15,753,079	11,334,218	2,227,078	.20
Dibutyl	7,923,771	5,661,733	942,134	.17
Diethyl	1,812,925	1,373,457	240,072	.17
(B) Non-coal-tar:				
Plasticizers: Total	6,031,548	5,069,738	1,674,049	.33
Dibutyl tartrate	23,354	23,197	10,197	.44

Table 3.—Cellulose Plastic Products

These monthly statistics on production and consumption in reporting company plants of cellulose plastic products (sheets, rods, and tubes) and production of cellulose acetate molding compositions were released by Director William L. Austin, Bureau of the Census, Department of Commerce. The data for sheets, rods, and tubes were compiled from the reports of 10 manufacturers. The data for cellulose acetate molding composition were compiled from reports of 7 manufacturers for January 1939, 8 manufacturers for February to December 1939, and 6 manufacturers for the year 1938. The data represent practically the entire industry:[1]

	Cellulose Nitrate					Cellulose Acetate			
Year and Month	Production of Sheets	Production of Rods	Production of Tubes	Sheets, Rods, and Tubes Consumed in Reporting Company Plants[2]	Total Production	Production of Sheets, Rods, and Tubes	Sheets, Rods, and Tubes Consumed in Reporting Company Plants[2]	Production of Molding Compositions	Total Production
1939	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
January	641,575	233,530	48,284	242,280	923,389	896,122	6,409	725,438	1,621,560
February	712,212	267,790	69,293	256,846	1,049,295	988,719	8,586	871,362	1,860,081
March	917,274	311,893	85,841	342,458	1,315,008	1,077,560	14,360	962,864	2,040,424
April	802,067	255,918	58,420	286,800	1,116,405	508,264	11,555	736,091	1,244,355
May	755,527	221,139	59,539	249,100	1,036,205	490,684	9,861	781,810	1,272,494
June	704,235	188,714	63,772	296,746	956,721	446,093	9,218	794,644	1,240,737
July	697,609	226,630	54,495	220,846	978,734	561,018	6,132	644,950	1,205,968
August	759,235	243,985	65,426	326,079	1,068,646	1,041,430	6,915	1,034,152	2,075,582
September	861,073	219,012	84,253	327,778	1,164,338	705,640	7,375	1,311,688	2,017,328
October	967,740	262,792	84,155	310,708	1,314,687	713,241	14,249	1,410,108	2,123,349
November	982,732	286,736	91,391	345,582	1,360,859	725,119	9,725	1,198,847	1,923,966
December	750,269	283,258	55,358	271,003	1,088,885	987,017	14,073	1,182,974	2,169,991
Total 1939	9,551,548	3,001,397	820,227	3,476,226	13,373,172	9,140,907	118,458	11,654,928	20,795,835
Total 1938	6,616,787	2,237,395	633,744	2,653,413	9,487,926	6,830,506	92,583	7,394,291	14,224,797
Total 1937	13,582,778	3,157,525	982,006	3,436,459	17,722,309	13,235,062	124,900	(3)	(3)

[1] Ed. Note: Taking 80c per lb. as an estimated unit value for cellulose plastics, their total production of 34,169,007 pounds in 1939 may be valued at $27,000,000.

[2] Included in production figures.

[3] Molding compositions not called for on schedule for 1937.

Plastics Digest

This digest includes each month the more important articles (wherever published) which are of interest to those who make plastic materials or use them. Requests for copies of the magazines mentioned should be directed to the individual publishers whose addresses will be mailed upon receipt of a self-addressed stamped envelope.

General

SCIENCE AVERTING U. S. RUBBER CRISIS. Business Week 42–3 (June 15, 1940). *Butyl* rubber, a new development of the Standard Oil Co. of N. J., is described as "more nearly a straight petroleum product" than their *Buna* product. *Ameripol*, also made from petroleum by the B. F. Goodrich Co., is being used for the manufacture of tires at the rate of 500 to 1000 per week. These are expected to go on sale in July at a cost one-third higher than the natural rubber tires.

PLASTICS AND CHEMICALS FROM WOOD. R. M. Boehm. Paper Trade J. *110*, 35–8 (May 2, 1940). A review of Masonite products, ranging from *Cellufoam* having a specific gravity of about 0.016 and a tensile strength of 6 lb. per sq. in. to *Benalite* of specific gravity 1.45 and tensile strength 10,000 lb. per sq. in. Nature has produced woods ranging in specific gravity only from about 0.11 (balsa wood) to 1.3 (lignum vitae wood). Thus, the specific weight range of the materials obtained in the laboratory from wood is about 8 times greater than that of the natural products.

SHELLAC. Bulletins recently received on this subject include the following. From the London Shellac Research Bureau: "Abstracts Bearing on Shellac Research Literature for the Period January 1 to December 31, 1939" and "Hot Spraying of Shellac." From the Indian Lac Research Institute: "Shellac-Casein Molding Powder" by M. Venugopalan and H. K. Sen; "Measurement of Gloss, Transparency and Color" by N. N. Murty; and "Shellac in Molding and Varnishing Industries" by H. K. Sen. From the Shellac Research Bureau of the Polytechnic Institute of Brooklyn: "Shellac in Wax Polishes" by Wm. H. Gardner.

Materials and Manufacture

COAL BY-PRODUCTS. PROPERTIES OF HYDROGENATED INDENE-COUMARONE RESINS. W. H. Carmody and H. E. Kelley. Ind. and Eng. Chem. *32*, 771–5 (June 1940). Hydrogenation of commercial indene resins has given rise to polymers which are resistant to ultraviolet light and atmospheric oxidation and show reduced discoloration on exposure to weathering conditions. The products are suitable for lining tanks, cans, and other articles which must withstand mineral acids and salt solutions. They are compatible with many other resins, synthetic rubbers, and ethylcellulose.

DERIVATIVES OF NATURAL RESINS AND THEIR POLYMERIZATION. R. Bhattacharya. Chem. and Ind. (London) *59*, 325–8 (May 11, 1940). As most natural resins are unsaturated compounds, it should be possible to introduce several hydroxyl groups by controlled oxidation or by other means and then modify or polymerize the resins further. Products possessing fairly large molecules can thus be obtained and the natural resins may no longer depend upon drying oils, particularly tung oil, to confer desirable qualities as varnishes on them.

BRITTLENESS IN CELLULOSE ACETATE. Z. Rogovin and I. Denker. Zhurnal Prikladnoi Khimii *13*, 255–62 (Feb. 1940). Embrittlement of films formed from primary acetate made with perchloric acid catalyst was studied with respect to the influence of such plasticizers as phthalates, phosphates, and diglycol diacetate. Other factors such as pretreatment of the linters and acid catalyst concentration were also investigated. Two expedients were found helpful in avoiding brittleness while retaining the advantages of perchloric acid as a catalyst. One is pretreatment of the cellulose with acetic acid containing a little sulfuric or hydrochloric acid; the other is use of a blended catalyst containing both sulfuric and perchloric acids.

(Translation available from Hooker Scientific Library, Central College, Fayette, Mo.)

Molding and Fabricating

CHROMIUM PLATING AN INDISPENSABLE ADJUNCT TO THE TOOL ROOM. Brit. Plastics *11*, 468–71, 486 (Apr. 1940); 514–8 (May 1940). Description of equipment and processes for plating dies and machine tools.

PLATING PROTECTS PLASTIC MOLDS. Edwin Smith. Am. Mach. *83*, 1072–3 (Dec. 27, 1939). The thickness of chromium generally employed on molds used with synthetic resins is 0.0004 to 0.0005 in. As soon as the slightest sign of steel is seen, the mold should be stripped of all remaining chromium, polished, and replated. Molds handled in this manner may be replated indefinitely.

Applications

PLASTICS IN BUILDING. Architectural Forum *72*, 413–7 (June 1940). A review of the uses of plastics in the building industry. The plastics are discussed under the subject headings: Decorative laminates, Resin-bonded plywood, Molded products, and Cast, extruded, sheets, rods, tubes.

PLASTIC COVER GLASS. H. C. O'Brien and R. T. Hance. Science *91*, 412 (Apr. 26, 1940). Isobutyl methacrylate resin may be used to cement a cover glass over tissue sections on microscope slides or can be used to completely replace the cover glass.

"VINYLITE" SERIES V RESINS. J. R. Price. India Rubber World *102*, 47–9, 52 (June 1940). A review of the uses of plasticized copolymers of vinyl chloride and vinyl acetate, including umbrella coverings, raincoats, smocks, uppers for sport shoes, travelling cases, belts, corrosion-resistant tape, and extruded tubing.

SEMI-RESIN FINISHES. W. W. Trowell. Am. Dyestuff Reporter *29*, 248–50 (May 13, 1940). An enumeration of the advantages of incorporating synthetic resins in starch sizing mixes for textile treatments.

DEVELOPMENTS IN SYNTHETIC RESINS AND RESIN EMULSIONS. F. J. Myers. Paper Trade J. *110*, 27–30 (Apr. 11, 1940). A survey of the present status of the use of synthetic resins of all types in treating paper.

Testing and Properties

LAMINATED WOOD. Brit. Plastics *11*, 534–5 (May 1940). Changes in dimensions and weight of laminated wood heated at 110 deg. C., immersed in water at 20 deg. C., and exposed to the weather, respectively, for 21 days are reported.

CHEMICAL EXAMINATION OF UREA COATING RESINS. J. J. Levenson, Jr. Ind. Eng. Chem., Analytical Ed. *12*, 332–7 (June 15, 1940). Methods for determining formaldehyde and butanol in urea coating resins are described. Curing in the early stages proceeds chiefly by loss of water and in the latter stages principally by loss of butanol and formaldehyde. The butanol content of highly cured resins of this type is about 25 to 32 percent.

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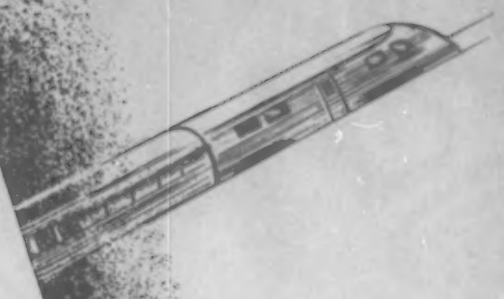

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U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C. at 10 cents each.

CASEIN GLUE. Eugen Abramowitsch. U. S. 2,197,168, Apr. 16. A neutral casein glue which remains usable at least 24 hours after preparation is made by stirring casein with water, adding 1 gram-equivalent of alkali (or less) per kilogram of casein, and finally adding up to 1 gram-molecule of formaldehyde.

CHEWING GUM. G. A. Hathere[illegible] (to Frank A. Garbutt). U. S. 2,197,240, Apr. 16. Use of an olefin-diolefin resin in a chewing gum base.

CASEIN FIBER. E. O. Whittier and S. P. Gould (to the People of the United States). U. S. 2,197,246, Apr. 16. Artificial fibers are made of casein, a casein salt and amyl lactate or a short chain dicarboxylic acid.

ACETAL. H. B. Smith; H. B. Smith and D. R. Swan (to Eastman Kodak Co.). U. S. 2,197,420–1, Apr. 16. Plasticizing polyvinyl acetal resins with tetrahydrofurfuryl oxalate or tetrahydrofuroate.

ABRASIVES. J. N. Kuzmick (to Raybestos-Manhattan, Inc.). U. S. 2,197,552, Apr. 16. Use of shellac, rubber or a synthetic resin as primary bond, and selenium, tellurium or a sulphide thereof as a secondary bond for abrasive grains.

SANDPAPER. H. G. Bartling (to Minnesota Mining & Mfg. Co.). U. S. 2,197,629, Apr. 16. Bonding abrasive grains to a flexible backing with an isomerized rubber derivative which retains the same softening point even after the repeated heating to which the bond is subject in use.

AMINE RESIN. A. G. Hovey and T. S. Hodgins (to Reichhold Chemicals, Inc.). U. S. 2,197,723, Apr. 16. Making a resin by fusing lactic acid with isobutylamine, pyridine, dioctylamine or aniline.

LIGNOCELLULOSE PLASTIC. A. G. Hovey and T. S. Hodgins (to Reichhold Chemicals, Inc.). U. S. 2,197,724, Apr. 16. Condensing the ingredients of a thermosetting phenol-formaldehyde or urea-formaldehyde resin with the lignin component of hydrolyzed lignocellulose, dehydrating the product and heating in vacuum to form a molding composition.

BOMB. C. E. Slaughter (to Ellis Laboratories, Inc.). U. S. 2,197,841, Apr. 23. A hardened synthetic resin fuse in an explosive projectile has a metal reinforcement, so designed that the fuse cannot rotate around the reinforcement.

ALKYD RESIN. C. Ellis (to Ellis-Foster Co.). U. S. 2,197,855, Apr. 23. Modifying an alkyd resin with a fatty acid acid having several double bonds, and with boric acid.

SYNTHETIC WOOL. J. B. Miles, Jr. (to E. I. du Pont de Nemours and Co.). U. S. 2,197,896, Apr. 23. Crimped wool-like fibers are made from a synthetic linear polymer; the fibers have at least 40 percent crimp retentivity and their x-ray patterns show orientation along the fiber axis.

PHENOLIC RESIN. A. N. Sachanen and P. G. Waldo (to Socony-Vacuum Oil Co.). U. S. 2,198,318, Apr. 23. Condensing a phenol with formaldehyde in presence of a petroleum tar with high aromatic content.

WATER-SOFTENING RESIN. C. Ellis (to Ellis-Foster Co.). U. S. 2,198,378, Apr. 23. A lead, bismuth, nickel, aluminum or tin adduct of a phenol-formaldehyde resin is used for removing the bicarbonate ion from water.

RADIO CABINET. Wm. J. B. Stokes, 2nd (to Joseph Stokes Rubber Co.). U. S. 2,198,465, Apr. 23. A radio cabinet, molded from a thermoplastic having low heat conductivity, is shielded from overheating by a polished metal plate interposed between the cabinet wall and the heat-generating tube.

PROTEIN FIBER. T. Kajita and R. Inoue (to Showa Sangyo Kabushiki Kaisha). U. S. 2,198,538, Apr. 23. Making artificial fibers from soybean casein by extracting the casein from soybean material with dilute alkali, precipitating with acid, adding sugar while the precipitate is wet, and dissolving in alkali to produce a spinning solution.

CASEIN PAINT. F. C. Atwood (to Atlantic Research Associates, Inc.). U. S. 2,198,596, Apr. 30. A concentrated low viscosity pigmented casein paint contains 5–15 percent sodium formate (calculated on the weight of casein) and does not suffer viscosity changes by reason of casein hydrolysis.

FILM CASTING. E. F. Izard (to E. I. du Pont de Nemours and Co.). U. S. 2,198,621, Apr. 30. A casting support for making transparent foils is coated with polyvinyl alcohol or a water-soluble derivative thereof.

CAN LINING. C. E. MacManus (to Crown Can Co.). U. S. 2,198,630, Apr. 30. Lining tin cans with chlorinated rubber.

RESIN SOLUTIONS. C. N. Smith (to Carbide and Carbon Chemicals Corp.). U. S. 2,198,794, Apr. 30. Rapidly forming dispersions or solutions of vinyl chloride : vinyl acetate resins by wetting the resin with a nonsolvent and agitating with a ketone solvent.

MOLDED ARTICLE. E. R. Dillehay (to Richardson Co.). U. S. 2,198,805, Apr. 30. Making pressed and cured laminated sheeting by passing fibrous stock successively through an aqueous and an alcoholic resin solution, laminating the layers and molding.

WATER SOFTENING. E. L. Holmes (to Permutit Co.). U. S. 2,198,874, Apr. 30. Softening water by passage through a bed of granular synthetic resin derived from a carbohydrate and *m*-phenylenediamine or a derivative thereof.

MOISTURE-PROOF FOIL. C. F. Silsby (to Solvay Process Co.). U. S. 2,198,886, Apr. 30. Regenerated cellulose transparent foils are moisture-proofed with a fusible alkyd resin made from succinic acid and glycerol.

CORROSION PREVENTION. C. H. Hempel (to Heresite & Chemical Co.). U. S. 2,198,939, Apr. 30. Forming on metal a smooth, impermeable coating of an oil-free potentially reactive phenol-formaldehyde resin pigmented with 10 to 45 percent by volume of an inert inorganic pigment.

VINYL RESINS. H. Müller (to Siemens-Schuckertwerke Akt.). U. S. 2,198,970, Apr. 30. Plasticizing vinyl chloride resins or their chlorinated derivatives with alkylaryl compounds in which the alkyl side chain has at least 10 carbon atoms.

(Please turn to next page)

INSULATION. Helge Rost. U. S. 2,198,977, Apr. 30. Electrical insulation is made of organic polymers, the monomeric molecules of which are electrically symmetrical and have approximately zero electric moment.

CHLORINATED RESIN. A. A. Levine and O. W. Cass (to E. I. du Pont de Nemours and Co). U. S. 2,199,026, Apr. 30. Chlorinating polymers of dihydronaphthalene or dihydroacenaphthene.

INJECTION MOLDING. J. B. Tegarty (to Standard Products Co.). U. S. 2,199,144, Apr. 30. An improved injection method for high pressure injection molding of articles such as steering wheels.

MOLDED ARTICLES. A. Gams and G. Widmer (to Ciba Products Corp.). U. S. 2,199,155, Apr. 30. An odorless transparent alkali-proof hot-molded product is made from an arylamine-formaldehyde resin and is tough, with high mechanical strength and insulating power.

SPINNING BUCKET. Thomas L. Gatke. U. S. 2,199,197, Apr. 30. A spinning bucket has a molded receptacle, the side wall of which is made of acid-proof phenolic resin reinforced by strands of metal.

SYNTHETIC FIBER. E. V. Lewis (to E. I. du Pont de Nemours and Co.). U. S. 2,199,411, May 7. A linear polyamide resin fiber is shrunk by dry heat so that it is sufficiently unset for uniform stitch weaving or knitting.

NONFLOCCULATING FINISH. Wm. Charlton, R. Hill, E. E. Walker and R. B. Waters (to Imperial Chemical Industries, Ltd.). U. S. 2,199,557, May 7. A nonflocculating pigmented coating contains a resin formed by interpolymerizing a methacrylate ester with acrylic or methacrylic acid.

LAMINATED SHEET. A. Renfrew and Wm. E. F. Gates (to Imperial Chemical Industries, Ltd.). U. S. 2,199,597, May 7. Use of a methacrylate ester monomer-polymer mixture, sprinkled with powdered polymethacrylate ester, as adhesive in laminated sheet materials.

RESISTOR. D. W. Light (to American Cyanamid Co.). U. S. 2,199,803, May 7. In a molded electric resistor the resin binder is improved in curing speed, stability and heat resistance by blending with an aminotriazine-aldehyde condensation product.

ALKYD RESIN. G. S. Weith (to Bakelite Corp.). U. S. 2,199,900, May 7. A shock-resisting resin formed by blending an infusible, insoluble alkyd with a heat-hardenable nonalkyd resin.

ACETAL RESIN. J. B. Hale (to Eastman Kodak Co.). U. S. 2,199,992, May 7. Stabilizing a polyvinyl acetal resin by treatment with hydrogen.

CREPING FABRICS. P. Schlack (to I. G. Farb. Akt.). U. S. 2,200,134–5, May 7. Producing shrinkage and crepe effects in acetate silk or the like with the aid of polyvinyl ethers, or their interpolymers with maleic anhydride, or with acidic alkyd resins, or with polyacrylamide resins.

VISCOUS POLYMER. A. Voss and W. Heuer (to I. G. Farb. Akt.). U. S. 2,200,437, May 14. High viscosity vinyl ester polymers are formed by interpolymerization with an unsaturated compound in presence of a long chain fatty acid peroxide.

SAFETY GLASS. C. Ellis (to Ellis-Foster Co.). U. S. 2,200,691, May 14. Use of a light-stable acid-catalyzed urea-formaldehyde resin as the adhesive for a cellulose derivative interlayer in safety glass.

RUBBER-LIKE POLYMER. W. Sandhaas, W. Daniel and K. Mühlhausen (to I. G. Farb. Akt.). U. S. 2,200,705, May 14. Interpolymerizing 3 parts of butadiene with 1 part of a vinyl-acetylenyl carbinol in aqueous emulsion.

ORGANOGEL. E. Trommsdorff (to Röhm and Haas Co.). U. S. 2,200,709, May 14. Dissolving a hydrolyzable polymer in a solvent which will not dissolve the hydrolysis product, and converting the solution to a gel by hydrolyzing not over 30 percent of the polymer.

RUBBER ISOMER. A. Greth and J. Reese (to Resinous Products and Chemical Co.). U. S. 2,200,715, May 14. Forming a rubber isomer by heating rubber with a phenol and an inorganic acid.

ALDEHYDE RESINS. G. K. Anderson, E. A. Taylor and J. B. Fishel (to Neville Co.). U. S. 2,200,762–3, May 14. Forming a resin by condensing aromatic hydrocarbons with an aldehyde in presence of an ether: sulphuric acid reaction product.

SOUND RECORDS. O. M. Dunning and C. T. Jacobs (to Thomas A. Edison, Inc.). U. S. 2,200,918, May 14. Covering a sound record with a thin skin of chlorinated rubber.

CREASEPROOFING TEXTILES. Perry M. Moore. U. S. 2,200,931, May 14. Stabilizing urea-formaldehyde resins against conversion to the insoluble form by adding an aqueous paraffin wax emulsion, and using the resin solution in waterproofing and creaseproofing fabrics.

SAFETY GLASS. J. D. Ryan and J. D. Gwyn (to Libbey-Owens-Ford Glass Co.). U. S. 2,200,969, May 14. A polyvinyl acetal resin interlayer for safety glass is plasticized with a dialkyl sebacate.

RESINIFICATION ACCELERATOR. E. H. Balz (to Plaskon Co.). U. S. 2,201,021, May 14. Using N-methylsaccharin as a latent accelerator in thermosetting urea-formaldehyde resins, for molding compositions.

UREA RESINS. D. E. Cordier (to Plaskon Co.). U. S. 2,201,027–8, May 14. Using cyanothioformamide as a latent accelerator in thermosetting urea-formaldehyde resins; and plasticizing such resins with N-alkanol aromatic sulphonamides.

RUBBER HYDROCHLORIDE. E. Gebauer-Fuelnegg and E. W. Moffett (to Marbon Corp.). U. S. 2,201,034, May 14. Compounding rubber hydrochloride with chlorinated diphenyl, or chlorinated diphenyl ether, or chlorinated naphthalene.

GAS MASK FACEPIECE. R. Monro, A. V. Motsinger, H. A. Scruton and G. A. Little. U. S. 2,201,198, May 21. Facepieces for gas masks are made of fabric coated with nitrocellulose and assembled on opposite sides of a sheet of cellulose acetate to which the coated fabric is joined by heat and pressure.

METHACRYLATE RESIN. D. A. Fletcher (to E. I. du Pont de Nemours and Co.). U. S. 2,201,395, May 21. The polymerization of methacrylate esters is effected in presence of 3 to 14 percent of alpha-terpineol.

PETROLEUM PLASTIC. A. P. Anderson (to Shell Development Corp.). U. S. 2,201,466, May 21. A plastic prepared from petroleum is translucent in thin layers, practically free from asphaltenes, and less temperature-sensitive than are the asphaltic resins.

LINEAR POLYAMIDES. J. K. Owens and A. G. Scroggie (to E. I. du Pont de Nemours and Co.). U. S. 2,201,741, May 21. Improving the light fastness and heat resistance of polyamide resins by treatment with dilute alkali.

Book covers molded by
Belmont Molded Plastics, Inc.
for Chas. W. Breneman Co.

TENITE
makes the FRONT COVER

INJECTION-MOLDED TENITE for catalog covers is an innovation in the art of book binding. Raised lettering and decoration, etched into the mold, eliminate stamping, embossing, and tooling operations.

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TENITE REPRESENTATIVES. *New York*, 10 East 40th Street. *Buffalo*, 1508 Rand Building. *Chicago*, 2264 Builders' Building. *Detroit*, 904-5 Stephenson Building. *Leominster, Massachusetts*, 39 Main Street . . . Pacific Coast: Wilson & Geo. Meyer & Company—*San Francisco*, Federal Reserve Building; *Los Angeles*, 2461 Hunter Street; *Seattle*, 1020 4th Ave., South.

TENNESSEE EASTMAN CORP., KINGSPORT, TENN. *Subsidiary of the Eastman Kodak Company*

Foreign Plastics Patents

Application dates are given for patents of European countries, but for Canada the issue date is given.

DELUSTERANT. Societe pour l'industrie chimique a Bale. Swiss Patent 202,522, April 17, 1939. A bath for delustering glossy textiles contains a water-insoluble but acid-soluble urea-formaldehyde resin.

SAFETY GLASS. Bakelite, Ltd. British Patent 507,013, June 7, 1939. Resins for use as safety glass interlayers, and in other laminated products, are made by condensing a phenol first with polyvinyl acetate and then with formaldehyde.

THERMOSTAT CONTROLS. Vernay Patents Co. British Patent 507,501, June 15, 1939. Control elements for thermostats are made by dissolving a vinyl chloride resin or synthetic rubber (chloroprene) in a melt of diphenyl, dibromobenzene or dichlorobenzene and dispersing in the melt solution a powdered substance which conducts heat well, e. g., graphite, antimony, aluminum or copper powder, the melting point of the solvent being chosen to fall within the range in which the thermostat is to operate.

SYNTHETIC RUBBER RESINS. C. A. Redfarn and P. Schidrowitz; E. H. Farmer and J. W. Barrett (to R. P. R. Association). British Patent 507,995-6, June 23 and 22, 1939. Rubber is heated first with maleic anhydride and a phenol, then with an aldehyde to produce molding compositions; or products ranging from rubbery substances through fibrous products to brittle resins are formed by action of maleic anhydride on rubber, with or without a vinyl compound.

UREA RESIN. D. E. Edgar and P. Robinson (to Canadian Industries, Ltd.). Canadian Patent 387,224, March 5, 1940. Condensing urea with formaldehyde and an alcohol such as butanol, and acetylating the product, to form a resin which yields waterproof films.

VARNISH RESIN. B. E. Sorenson (to E. I. du Pont de Nemours and Co.). Canadian Patent 387,247, March 5, 1940. A resin which yields fast-drying finishes is obtained by precipitation with a hydrocarbon solvent from a solution of a urea-formaldehyde-alcohol resin.

WING FABRIC. W. M. Billing (to Hercules Powder Co.). Canadian Patent 387,258, March 5, 1940. A taut, light-fast, waterproof airplane wing fabric is made by impregnating fabric with cellulose acetopropionate or acetobutyrate.

ELECTRICAL INSULATION. Chemische Fabrik vormals Sandoz. Dutch Patent Application 84,815, Oct. 30, 1937. Cellulose acetate with exceptionally high electrical resistance is made by acetylating cellulose with the aid of an acid catalyst other than sulphuric or phosphoric acid, washing the product with electrolyte-free water and compounding it with electrolyte-free plasticizers.

VINYL RESINS. I. G. Farb. Akt. Dutch Patent Application 87,299, April 8, 1938. Adding hydrogen chloride to acetylene in presence of a mercury catalyst to produce vinyl chloride.

CABLE INSULATION. T. R. Scott, R. C. Mildner and T. E. D. Menzies (to Standard Telephones and Cables Ltd.). British Patent 508,036, June 26, 1939. Barrier joints in impregnated power cables are insulated with fabric which is impregnated with a polystyrene resin. The resin may be plasticized with rubber, polyisobutylene or the like.

CHLORINATED RUBBER. C. A. Redfarn and P. Schidrowitz (to R. P. R. Association). Brit. Patent 507,926, June 23, 1939. Continuous extrusion machine for making products from plastics which expand on release of pressure after extrusion, e. g., chlorinated rubber.

STABILIZING RESINS. U. S. Rubber Products, Inc. Brit. Patent 506,565, May 31, 1939. Synthetic resins and other products are stabilized by admixture with N-carbamyl-p-aminodiphenylamine or a homolog or derivative of this compound.

OLEFIN POLYMERS. Standard Oil Development Co. Dutch Patent Application 84,748, Oct. 27, 1937. Rubber-like products are obtained by polymerizing an olefin such as isobutylene and vulcanizing the polymer with sulphur monochloride.

SYNTHETIC FIBERS. N. V. de Bataafsche Petroleum Mij. Dutch Patent Applications 87,281 and 87,282, April 7, 1938. Making artificial fibers and fabrics from polymerized butadiene (or isoprene) with the aid of a solvent and a coagulant. The filament is hardened by heat, and may also be coated with a layer of colloidal sulphur.

FLOOR COVERING. I. G. Farb. Akt. Dutch Patent Application 85,782, Dec. 31, 1937. Floor or wall covering is made by polymerizing an unsaturated acid such as crotylidene-cyanoacetic acid and compounding the product with a filler.

TREATING FURS. Oscar F. Muller. Canadian Patent 387,369, March 12, 1940. Fixation of a synthetic resin on the fibers of fur is effected by treatment with a wax emulsion containing formaldehyde and another resin component, and resinifying by heat.

UREA RESIN. H. S. Rothrock (to E. I. du Pont de Nemours and Co.). Canadian Patent 387,411, March 12, 1940. Condensing urea with acetaldehyde in presence of an alcohol but without a catalyst.

ACETAL. B. C. Bren (to E. I. du Pont de Nemours and Co.). Canadian Patent 387,412, March 12, 1940. Making a polyvinyl acetal resin by condensing a polyvinyl compound with an aldehyde in presence of an acid catalyst, and neutralizing the catalyst with a water-insoluble amine.

POLYMERIC RESINS. Vereinigte chemische Fabriken Kreidl, Heller & Co. French Patent 840,900, May 5, 1939. Vapor phase polymerization of styrene, acrylic or methacrylic acid, vinyl esters or acrylate esters without using a solvent.

ACIDPROOF RESINS. I. G. Farbenindustrie Aktiengesellschaft. French Patent 841,028, May 9, 1939. Resins which are characterized by good elastic and adhesive properties and by complete inertness to inorganic acids are made by heating benzyl chloride or its homologs gradually to 180 deg. and adding a small amount of an amine, urea or formamide to the molten product.

ABRASIVE WHEEL. E. T. Rainier (to Dominion Rubber Co., Ltd.). Canadian Patent 367,523, March 19, 1940. A hardened phenolic resin, containing potassium chloride, is used as binder in abrasive wheels.

Product Appeal?

YOUR packages join the dress parade when DURITE is specified as the material from which they shall be molded. ¶ DURITE, the choice of leaders when called upon to mold for popular sales containers and other more intricate applications, provides strength, modern styling, and a lustrous, permanent finish. ¶ Make *your* product more appealing—more saleable. Write Durite Plastics, the exclusive producers of phenol-furfural resins.

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Publications

Write direct to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices.

Machine Shop Training Course, 2 Vols.

by Franklin D. Jones
The Industrial Press, 148 Lafayette St., New York, 1940
Price: Vols. I & II $6.00, either Vol. separately $4.00
Pages: Vol. I, 474; Vol. II, 552

Here is a particularly timely contribution to help in the present emergency in supplying the skilled labor which will be needed for the production of machine tools. The author covers both elementary and advanced shop practice, including fundamental principles, methods of adjusting and using different types of machine tools, cutting screw threads, thread grinding, gear cutting, precision toolmaking methods, typical shop problems, and miscellaneous facts relating to machine construction. This is a training course not only for the student and shop man, but also for engineers who recognize the importance of designing on paper to suit available production methods. The two volumes are replete with illustrations and are of exceptionally good quality with respect to both arrangement and physical make-up. They are highly recommended to anyone looking for a useful and convenient instruction or reference book on this subject. G. M. K.

Varnish Making

Chemical Publishing Co., Inc., 148 N. Lafayette St., New York, 1940
Price $6.00 **231 pages**

This volume brings together a group of papers presented at a conference of the Oil and Colour Chemists' Association in England. A special chapter on the "History of Varnish Making" serves to introduce discussions of synthetic drying oils, maleic acid resins, alkyd resins, oil-reactive phenolics, and various other topics related to materials, processes, and plant equipment used in the manufacture of varnishes. G. M. K.

Chemie und Technologie der Kunststoffe

Edited by R. Houwink
Published by Akademische Verlagsgesellschaft M. B. H., Leipzig, 1939
Price 42.40 RM. **625 pages**

Experts in several countries collaborated in the preparation of this survey of the chemistry and technology of plastics. The breadth and authoritative background of its contents can best be summarized by listing the following titles and authors of the various chapters: "Organic Chemistry of Plastics," by W. Kern; "Kinetics of Polymerization and Polycondensation Reactions," by G. V. Schulz; "Physics and Colloid Structure," by F. Horst Müller; "Electrophysics of Plastics," by P. O. Schupp; "Plastics from Phenol and Its Derivatives," by Hans Stäger; "Plastics from Carbamides," by G. Widmer and K. Frey; "Plastics from Carboxylic Acids," by J. Rinse; "Plastics from Ethylene Derivatives," by E. Trommsdorff; "Plastics from Cellulose," by James Craik; "Plastics from Casein and Other Proteins," by E. Haller; "Synthetic Rubbers," by E. Konrad; "Modified Natural Products," by A. V. Blom; "Testing of Films and Foils," by A. V. Blom; "Non-electrical Testing of Plastics," by W. Zebrowski; and "Electrical Testing of Plastics," by P. O. Schupp. Tables of the physical properties and classified types of German plastics and an extensive subject and author index contribute to the reference value of this book. G. M. K.

Henley's 20th Century Book of Formulas, Processes and Trade Secrets

Edited by G. D. Hiscox; revised by Prof. T. O'Conor Sloane
Published by Norman W. Henley Publishing Co., 2 W. 45th St., New York, 1940
Price $4.00 **880 pages, indexed**

A valuable source for helpful hints on almost everything to do or make, this revised edition contains hundred of formulas, recipes, etc., new methods, developments and practical trade information in almost every field imaginable. There are chapters on Adhesives, Cements, Casein, Plastics, Photography, Polishes, Waterproofing, Paints and other subjects. A special section on workshop and laboratory methods, glossary of materials and lists of common names of chemical substances are included. A comprehensive guide, this book is a handy, compact reference for laboratory, workshop, factory or home. H. B. J.

GEORGE GORTON MACHINE CO., RACINE, WIS., has issued a new 20-page illustrated catalog describing the construction and uses of the complete line of Gorton pantograph engraving machines and attachments.

THE 1940 ILLUSTRATED CATALOG OF INFORMATION about screws, bolts and nuts, including Pheoll-Phillips recessed head screws and bolts, is being distributed to the trade by Pheoll Mfg. Co., 5700 Roosevelt Road, Chicago.

CAMBRIDGE INSTRUMENT CO., INC., 3732 GRAND Central Terminal, New York, has issued illustrated descriptive folders on the Cambridge Electron-Ray pH meter and the Thermionic pH recorder, new precision instruments.

CHICAGO METAL HOSE CORP., MAYWOOD, ILL., HAS issued a new 40-page illustrated catalog on Rex-weld and Rex-tube flexible metal hose containing profuse technical data and a special section devoted to flexible metal hose engineering—Rex-bellows and C. M. H. stainless steel bellows, Avioflex for fuel lines and all-steel exhaust hose.

CONSTRUCTION AND SELF-LOCKING ACTION OF elastic stop nuts with a graphic listing of advantages of using them are concisely explained in a folder issued by Elastic Stop Nut Corp., 2332 Vauxhall Road, Union, N. J.

MAGNETIC SEPARATORS, A BULLETIN ISSUED BY the Magnetic Engineering & Mfg. Co., Clifton, N. J., describes high power magnetic pulleys and lists dimensions of standard sizes made, together with capacities. Technical data on choosing correct size of magnetic pulley required for all applications are given and construction and design features explained.

ENGINEERING STANDARDS AND TECHNICAL INformation on Aero-Thread, a high-strength screw system with anti-friction thread lining, are included in a 16-page bulletin issued by Aircraft Screw Products Co., Inc., 25-12 41st Ave., Long Island City, N. Y. Typical applications in the aircraft industry where it is now being employed are illustrated.

BAKEFLEX, A NEW PHENOLIC RESIN BASE FINISH for protecting floors and other surfaces from cigaret burns, stains, acids, grease, etc., is described in a folder recently issued by Flexrock Co., 23rd & Manning Sts., Philadelphia, Pa.

A NEW 12-PAGE REFERENCE CATALOG OF THE ENtire line of American Foundry Equipment Co., 555 South Byrkit Street, Mishawaka, Ind., presents a complete illustrated summary of the models and sizes of the following American products: Wheelabrator tumblasts, tablasts and special cabinets, "Dustube" dust collectors, sandcutters, core machines, flasks and jackets, rod straightener and shear machine, and sand blasters.

TAYLOR

VULCANIZED FIBRE
PHENOL FIBRE
TAYLOR INSULATION

What makes Taylor Fibre better fibre?

First, we are equipped to make all our own "raw materials"—paper, resins—hence we can control to rigid standards the materials which go into our products.

Second, through close laboratory supervision of every stage of manufacture—through the application of highly improved methods and equipment in the "world's most modern fibre mill"—the physical and electrical properties of Taylor Vulcanized and Phenol Fibre are uniformly maintained.

Third, Taylor goes all the way to serve you better. Offers not only vulcanized and phenol fibre in every grade and form required by modern industry—in sheets, rods, tubes, rolls and ribbon rolls—but makes the parts, if you wish, to your own specifications right at the mill. Accurate parts that facilitate assembly, reduce waste, provide dependable physical and electrical qualities.

Ask about Taylor "Planned Service" geared to your requirements whether large or small—insuring an unfailing source of supply and deliveries on schedule.

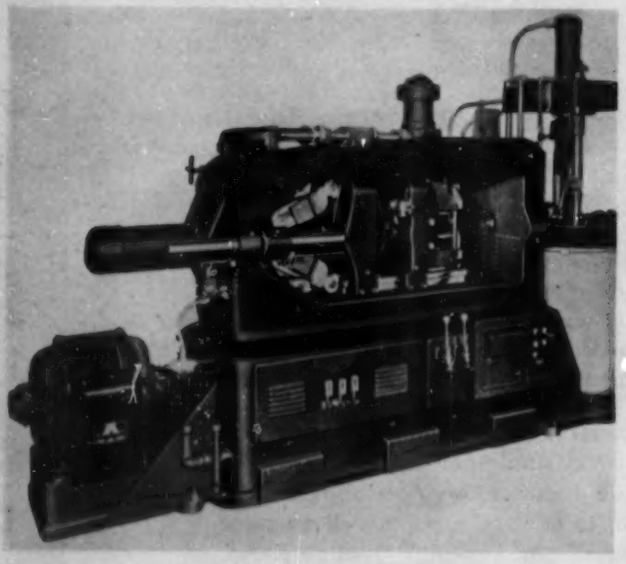
TAYLOR FIBRE COMPANY
NORRISTOWN, PA.

SHEETS
RODS
TUBES
FABRICATED PARTS

Machinery and Equipment

GENERAL ELECTRIC CO. HAS RECENTLY ANNOUNCED as a standard "unit" a complete speed-variator equipment operating from an alternating-current source of supply to provide wide ranges of adjustable speed by means of the well-known generator-voltage-control scheme. Each equipment consists of an adjustable-speed, direct-current motor, an adjustable voltage motor-generator set with control, and a separately mounted generator-field rheostat. Standard speed ranges are available up to 16:1 ratio.

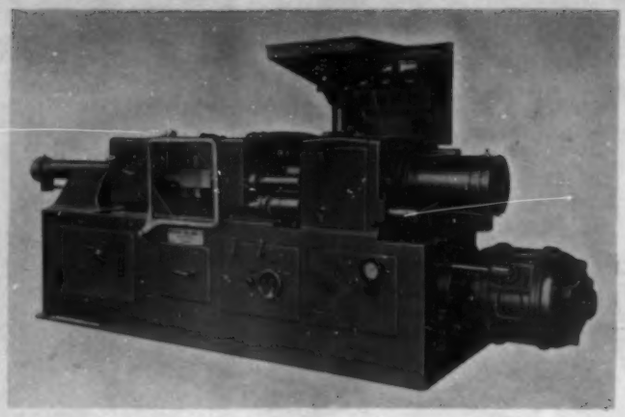
A NEW HIGH-POWERED MULTI-PURPOSE RECIPROcating action (as contrasted to revolving) tool has recently been placed on the market by H & H Research Co. With a stroke length of $^{5}/_{8}$ in., this machine is reported to develop a 30 to 40-lb. push or pull at the end of the chuck and may be used to file, burr, hone, snag, polish, saw and chip. A complete kit of accessories is available and it is said to be adaptable as a vertical or horizontal filing machine.



NEWEST MEMBER OF THE PHOENIX-LESTER FAMILY is this HHP-3 die casting machine (above) for either zinc or aluminum. According to the company report, there is no accumulator bottle used, and the hydraulic system delivers steady high pressure which reaches a peak when resistance is greatest. These high pressures in turn have demanded sturdy mold locking construction, so much so that tie rods were inadequate and solid beam construction was of necessity adopted. The worm and worm wheel adjustment movement of the movable platen are said to make mold installations speedy and secure parallelism of the platen faces and the mold faces.

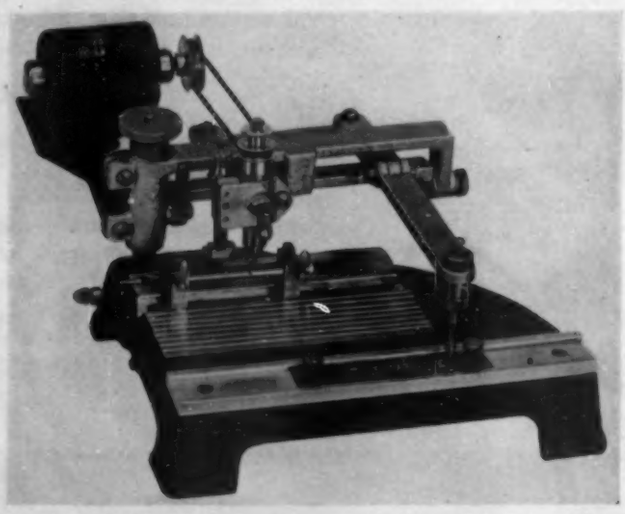
Locking pressures exerted by the toggle link lock reach a total of 400 tons on this particular press. Timing and sequence control of each operation is incorporated in the machine, with the added features of being able to control the pressure exerted on the injection piston and also the speed of travel of the piston.

QUICK ACCURATE TEMPERATURE READINGS OF plastics, revolving rolls, molds, platens and other surfaces are claimed possible with the improved Alnor portable surface pyrometer known as the Pyrocon. Rigid or flexible arms are removable and interchangeable and there is a choice of seven standard temperature ranges.



THIS NEW IMPROVED HYDRAULIC INJECTION MOLDing machine (above) for plastics, designed and built by the Watson-Stillman Co., is devised for faster operation, increased capacity and production, and economies in operation and maintenance, according to a recent release. One of its most distinctive new features is the zone heat control which provides ingeniously distributed heat, giving a greater plasticizing capacity to the heating cylinder. Large opening (24 in. maximum) between die plates, with adjustment of 18 in. on the clamping end, allows for the accommodation of dies 6 in. thick and up. The toggle-clamping device affords positive clamping of dies having up to 125 sq. in. projected area. Floor space is 196 by 45 inches.

Two material cylinders are available for use with this machine. The maximum weight of material injected per cycle with the $2^{3}/_{16}$-in. cylinder is 6 oz. at a pressure of 50,000 lbs. per square inch. With the $2^{3}/_{4}$-in. cylinder the maximum weight is 8 oz. at a pressure of 32,000 lbs. per square inch. The stroke of the injection plunger is 9 in.; speed of injection plunger 150 in. per minute. Arranged for full automatic and manual control.



DESIGNED TO REPRODUCE LETTERS, NAMES, DEsigns, emblems and signatures on small plastic and metal articles, Auto-Engraver (shown above) is claimed to cut smooth lines on flat or round surfaces rapidly and with depth of cut controlled. Letters are engraved from Master Type furnished with the machine and include both block and script fonts. The machine weighs 12 lbs., is $8^{1}/_{2}$ in. by 11 in. by 7 in. high and is motor-operated on A.C. or D.C. current.

What's New in Plastics?

PHOTO COURTESY FICKS REED COMPANY AND PIERCE PLASTICS, INC.

EXTRUDED ETHOCEL!

Small, Uniform, Cross-Section Units Having Great Dimensional Stability Can Now Be Extruded in Speeds Up to 150 ft. Per Minute from ETHOCEL.

Whether you manufacture porch furniture, automobiles or are a custom molder, this is news of vital interest to you. Extruded ETHOCEL* will not only cut your fabrication costs but improve the finished product as well.

ETHOCEL (a Dow Ethyl Cellulose plastic) resists weather, light, heat and aging, extrudes with a high gloss, and retains its finish under every ordinary condition. It can be extruded in ribbons or rods, solids or tubes to meet practically any specifications such as are required for the seats and backs of porch furniture and the interior trim of automobiles. There are practically no limitations as to color.

Dow is prepared to make extrusions of ETHOCEL and invites custom molders and manufacturers to learn more about this new plastic material which is easy and inexpensive to extrude. ETHOCEL plastic granules in varied colors are suitable for injection molding. ETHOFOIL* (Dow Ethyl Cellulose Film) is available as a transparent color film. Address inquiries to the Cellulose Products Division.

*Trade Mark Reg. U. S. Pat. Off.

DOW

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN • Branch Sales Offices: New York City, St. Louis, Chicago, San Francisco, Los Angeles, Seattle

In The Limelight

PURCHASE OF A CONTROLLING INTEREST IN PLASkon Co., Inc., Toledo, Ohio, by Libbey-Owens-Ford Glass Co. was announced June 26 by John D. Biggers, president of the glass company. Plaskon, with headquarters and manufacturing plants in Toledo and Grasselli, N. J., is one of the country's foremost producers of urea-formaldehyde molding compositions used by manufacturers of a wide variety of plastic products. The resin is sold as powder under the trade-name "Plaskon." The company was organized in 1930 as Toledo Synthetic Products Co. In 1936 it was reincorporated under its present name. Sales offices are maintained in New York City, Rochester and Chicago.

The organization will continue under its present management headed by James L. Rodgers, Jr., as president. His associate officers are Horton Spitzer, vice president; R. B. Harrison, vice president; C. O. Marshall, secretary; W. R. Feldtmann, treasurer. Dr. A. M. Howald, an outstanding authority on urea resins, will continue as director of research for Plaskon. The Board of Directors will consist of David Goodwillie, W. P. Pickhardt, and James L. Rodgers.

Present manufacturing and sales policies will continue to be maintained, it is reported. Libbey-Owens-Ford Glass Co. states that it will best follow the current developments in synthetic resins and those which will come in the future in this relatively new but promising industry through actual participation in the industry itself.

CELLULOID CORP., 180 MADISON AVE., NEW YORK, announces the appointment of Millard Demarest as Director of Sales of the Lumarith molding powder division, succeeding Wm. T. Cruse, who resigned to become Editor of MODERN PLASTICS. Mr. Demarest has served the company for 19 years in various departments and since 1938 has been director of sales of the fabricating division. He will be ably assisted by W. Raymond Porter, formerly head of the Detroit office. Since Mr. Porter's association with the company, he has been intimately identified with plastics development in the automotive industry.

HENRY W. HARDING REPORTS THAT HE IS NOW CONnected with Manufacturers Chemical Corp., Jersey City, N. J., producer of cellulose acetate molding material and lacquers.

THE DIRECTORS OF THE SOCIETY OF THE PLASTICS Industry have settled on the Buckwood Inn, Shawnee-on-Delaware, Pa., as the place for the fall meeting of the Society and Sunday, Oct. 13, Monday, Oct. 14, and Tuesday, Oct. 15, as the date. A comprehensive program of activities is being laid out which will cover not only the entertainment side but will put more emphasis on the serious, technical aspects.

A special quiz program is planned for Monday morning covering industrial problems and techniques. For the afternoon everyone so minded will participate in a "foozle golf tournament," the basic feature of which will be the privilege of replaying a certain number of strokes throughout the eighteen holes which did not turn out as originally planned. Monday evening the official dinner will be held with prizes for everyone to draw—golfers and non-golfers. Professional entertainment of all sorts will be in action from the afternoon through early Tuesday morning so no one should be bored at any time.

Reservation blanks will be sent to all members during the latter part of August.

GENERAL INDUSTRIES CO. HAS ANNOUNCED THE appointment of W. L. Kelly as their western representative, with headquarters at 2240 West 115th St., Chicago, Illinois.

J. E. WOLFE HAS BEEN APPOINTED GENERAL MANager of the Plastics division of Reynolds Spring Co., we are informed by J. D. Sherman, vice president and general manager.

GEORGE GORTON MACHINE CO., RACINE, WIS., manufacturer of milling, die and mold duplicating and engraving machines announces the completion of a new 12,000 sq. ft. factory addition. The new structure houses the assembly and shipping departments and a new stock room. The building, designed by Albert Kahn, Inc., Detroit, features the latest type of Cooper Hewitt fluorescent lighting and a blue tinted glass that eliminates sun glare, and is designed so that further additions may be added with a minimum of expense.

Although the building is primarily to relieve congestion in the assembly department, the company informs us that its machine output is expected to rise about twenty-five percent.

DEVELOPMENT OF TWO NEW SYNTHETIC RUBBERS has been announced recently which, it is said, will cut in half the nation's dependence on rubber imports. *Ameripol*, presented on June 5 by B. F. Goodrich Co., at a reception in the Waldorf-Astoria, New York, by John L. Collyer, president, and

S.P.I. **FALL MEETING** S.P.I.

SOCIETY OF THE PLASTICS INDUSTRY

BUCKWOOD INN, Shawnee-on-Delaware—Pennsylvania

OCT. 13—SUNDAY TO TUESDAY—OCT. 15

TECHNICAL SESSION
BUSINESS MEETING
ENTERTAINMENT

S.P.I. *WATCH THIS SPACE FOR DETAILS* S.P.I.

"ASK ELMES ABOUT THIS ACCUMULATOR"

Patent Applied For

You may have these striking advantages with an Elmes pistonless type air-ballasted hydraulic accumulator:

1. Line shocks are eliminated
2. Much less space required than with weighted accumulators
3. No special foundations are needed
4. Uniform pressure maintained by correct ratio between air and liquid
5. No internal packing; no internal moving parts

A typical Elmes hydraulic accumulator installation

EXPERIENCED

Accumulator Builders

Your success with an accumulator depends in no small measure upon the experience of the sponsor . . . not alone upon his general manufacturing background but his actual experience building accumulators. Elmes is one of the oldest American manufacturers of air-ballasted accumulators and can refer to scores of installations . . . all operating satisfactorily. Send today for specifications regarding Elmes Accumulators and a list of users.

CHARLES F. ELMES ENGINEERING WORKS

225 N. MORGAN ST. Chicago . . . SINCE 1851 . .

GENERAL ABNER DOUBLEDAY COVERED A WIDE RANGE

This able Union general was more than a brave soldier and capable commander. He was gifted with a versatile mind which ranged in many fields, including the study of ancient and modern languages. His name will best be remembered, however, in the history of athletics as the inventor of the modern game of baseball.

GENERAL INDUSTRIES

molded plastics serve in many fields

In a wide diversity of industries General Industries molded plastic parts are serving efficiently and economically—in radio, household appliances, automotive accessories, motor parts, machine parts, and others too numerous to mention.

Whether your requirements call for the production of a big unit or for a long run of millions of small parts, General Industries has the modern equipment and the plant capacity to produce your needs accurately, economically and to make deliveries on time.

If you want to be assured of high quality, prompt deliveries and favorable costs, make us your supplier for molded plastic parts. Send us blueprints and indicate your monthly requirements.

The GENERAL INDUSTRIES Co.

Molded Plastics Division

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Dr. W. L. Semon, research chemist, is the "Liberty rubber" derived from petroleum by a cracking process which breaks petroleum down to a mixture of simple molecules. From this mixture a gas is separated which under pressure liquefies to give butadiene. This is mixed with other ingredients prepared from natural gas and air and then made into milky emulsion. Upon heating and agitation, these ingredients react to form an emulsion of synthetic rubber, similar to latex obtained from rubber-producing trees. From there on the process of obtaining sheeted rubber is similar to that used for natural rubber.

The discovery of *butyl*, a synthetic rubber also derived from petroleum was announced on June 4 by the Standard Oil Co. of New Jersey at a stockholders' meeting. The company is also preparing to make *buna* (another type of rubber-like substitute) under license from German interests, and in cooperation with Firestone Tire & Rubber Company.

HANSON-VAN WINKLE MUNNING CO., MATAWAN, N. J., states that C. W. Yerger has been promoted to the post of executive vice president and L. M. Hague has been made vice president in charge of sales.

A NEW SERIES OF SOUND MOTION PICTURES WERE released July 1, by The Film Productions Co., Minneapolis, Minn. They are reported to contain no entertainment material of any kind, provide simple and practical instruction in all phases of mechanical trades, such as die and tool making, precision measuring and layout methods, machine set-up and operation, and related subjects.

SCHWAB & FRANK REPORT THE REMOVAL OF THEIR plastic laboratories to 214 Marquette Bldg., 243 W. Congress, Detroit. Telephone, RAndolph 5363.

HOWARD KETCHAM, INC., INDUSTRIAL DESIGNER reports the removal of his offices to the penthouse at 607 Fifth Ave., New York. Telephone: PLaza 8-1511.

TWO NEW LINES OF ENAMELS, ESPECIALLY DEsigned to work at high speed baking schedules in infra-red lamp (radiant heat) ovens, are announced by Maas & Waldstein Co. makers of industrial finishes, Newark, N. J. Their use is said to allow the finisher to take full advantage of the principal features of rapid infra-red lamp baking, little wasted heat, etc.

COLONIAL KOLONITE CO., CHICAGO, STATES THAT G. T. Williams, formerly Detroit representative for the Catalin Corp., is now representing the company in Michigan and Ohio.

DRELL NOVELTY MFG. CO., NEW YORK, ANNOUNCES a new department devoted exclusively to the production of plastic ornaments and novelties.

A GROUP MOVEMENT OF INDUSTRIAL DESIGN APpears to be headed into the fields of furniture and home furnishings where plastics may achieve rather broad recognition as a fundamental material. American designers, according to a publicity release from Louise V. Sloane, have come to the conclusion that now, as never before, there is a need for concerted action to bring to the American home products designed and produced in this country, styled to the living habits and needs of citizens of U. S. A.

Therefore, a group of designers, artists, craftsmen, manufacturers and retailers in the home furnishings industry have organized to do business under the name of "American Way" for the purpose of coordinating and accelerating the art-in-industry movement in this country. By fall this year, it is expected that at least one retail store in each community will offer the products of these artists and craftsmen through a well-laid merchandising plan and that the "American Way" will be advertised through national channels.

JAMES H. CRITCHETT, VICE PRESIDENT OF ELECTRO Metallurgical Co., and of Union Carbide and Carbon Research Laboratories, Inc., New York, and former president of the American Electro Chemical Society, has been appointed a member of the National Research Council in the Division of Chemistry and Chemical Technology.

LA MODE PLASTIC CO., INC., PLASTICS FABRICATOR, has moved to newly equipped quarters at 242 W. 38th St., New York. Telephone: LAckawanna 4-9593.

DUREZ PLASTICS & CHEMICALS, INC., NORTH TONAwanda, N. Y., announces a new arc-resistant phenolic molding compound called Durez 8685. This new material was formulated specifically to prevent tracking where there is combined electrical spark and rubbing action. It is reported to have high resistance to carbonization under an arc. While slightly slower to cure in the mold, its electrical properties are said to be increased by baking after molding, and to hold its high dielectric strength when used at moderately high temperatures.

ANNOUNCEMENT IS MADE OF THE FORMATION OF the Plastics Industries Technical Institute to be located in Los Angeles, Cal. Organizers of the venture state that it will teach all phases of plastics, including application, fabrication, design, research and sales.

The school has appointed as technical director Mr. John Delmonte, former instructor in plastics at Armour Institute, Chicago, and also formerly assistant chief engineer of the Chicago Flexible Shaft Co., Chicago, Illinois. In charge of Art and Design is Frederick Selje, former director of interior art and body design of the Chrysler Corp. Others associated with the institute are as follows: Francis Gudger, formerly with the Arlington Division of E. I. du Pont de Nemours & Co.; Ralph Hemphill, chairman of Board of Directors of Aero Industries Technical Institute, and of the Plxweve Aircraft Corp.; Dr. Paul Ivey, sales research and merchandising director, now professor of sales research and merchandising at University of Southern California; Horace Blackman, Sr., former sales manager of the Parker Pen Co.

It is stated that the first course of instruction at the institute will begin as of September 16th.

IF YOU ARE INTERESTED IN REPRESENTATION IN India, J. N. Iyer invites correspondence. He can be reached at Indian Plastics Co., Round Building, Princess St., Bombay, No. 2, India, where he conducts a common sales organization devoting its efforts to plastic products.

A METHOD HAS BEEN DEVISED BY FRANK DUTCHER, New York, for melting into place watch crystals made of Lucite so that they cannot fall out. Added to this advantage is the virtual unbreakability of the plastic, and its slight magnification of the watch numerals.

The plastic is cut and domed to conform to the shape of the watch face, but is made about 2 mm. overside. The watch bezel is put in a machine, and by means of an electrical process, the bezel is short-circuited, creating a heat of about 250 deg. F. Next the machine is brought in contact with the plastic piece. The heat of the bezel penetrates and bites off the amount of plastic needed to fill properly the particular bezel. In this way the crystal is hermetically sealed, according to the report.

Sorry!

IT HAS BEEN CALLED TO OUR ATTENTION BY THE Metallizing Engineering Co., Inc., that in the article, "Forming Molds by Spraying Metal" which appeared in our June issue, there was no mention of the fact that the process described is covered by patents and patents pending. The company has asked us to mention this and also states that the process is available to the industry on a licensing basis.

(*Please turn to next page*)

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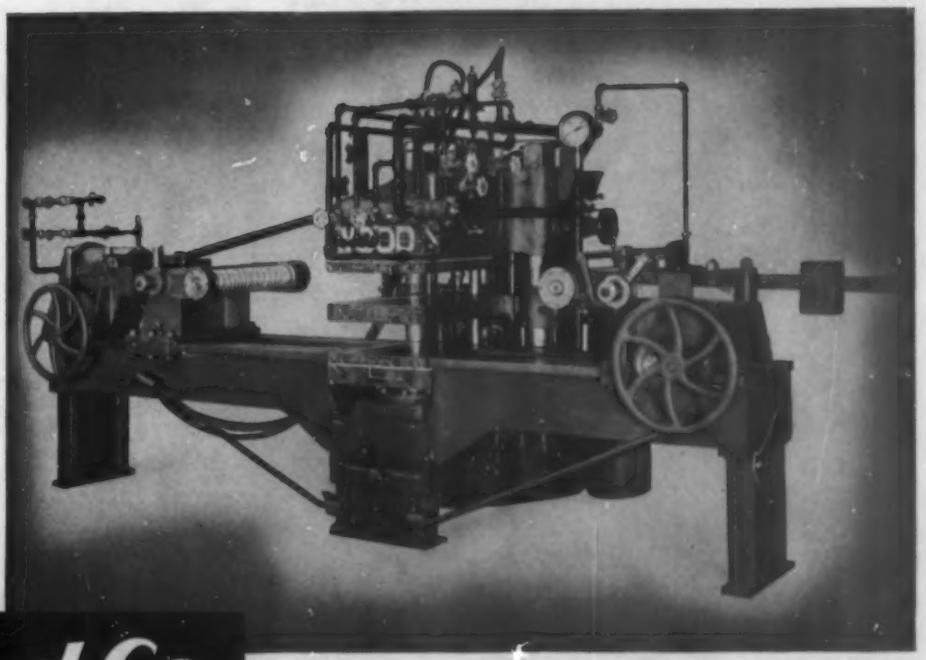

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ANNOUNCEMENT THAT A LARGE NEW PLANT FOR the production of Resinox phenolic resins and molding compounds is being added to the Plastics Division of Monsanto Chemical Co. at Springfield, Mass., highlights once again the basic importance of these materials in the plastics industry.

The plans for the new plant also emphasize the growth of plastics to an important place in the country's industrial picture. An investment in a plant of this size is an indication that plastics have come of age and of the confidence placed in the future of these materials. Adequate productive capacity and well-financed development are now accepted as necessary.

Resinox Corp., now a part of Monsanto's Plastics Division, was formed in 1930 as a joint undertaking of Corn Products Refining Co. and Commercial Solvents Corp. Shortly after the purchase of Resinox Corp., plans for expansion in several directions were made by the company. Construction of a new building (Fig. 1) devoted entirely to research in plastics has recently been completed. It is said to be equipped with every conceivable aid to modern research. Large sections, for instance, are air-conditioned with temperature and humidity varying not more than 2 deg. Centrally located pumps provide several different pressures and vacuum throughout the building by special piping. A considerable part of these facilities are devoted to research in thermosetting plastics. In addition, research will continue to be carried on in other plant laboratories in St. Louis and at the central laboratories of the company at Dayton, Ohio.

Some time after Monsanto took over the Resinox plant, it became apparent that the capacity of the equipment at Edgewater, N. J., was not adequate to meet sales potentials, and it was decided to construct a new plant adjacent to the present buildings of the plastics division. The new plant (Fig. 2), it is reported, will be a model of functional design, chemical engineering and industrial architecture, with the latest equipment for making plastics. Tall kettles, several stories in height, and jacketed in high-pressure steam will receive charges of various chemicals. Later, clear liquid pours out, to cool and harden into amber-like resins. They will then be broken up for further compounding on great mixers, grinders and rolls which will work and rework the material until eventually it is ready to be shipped out.

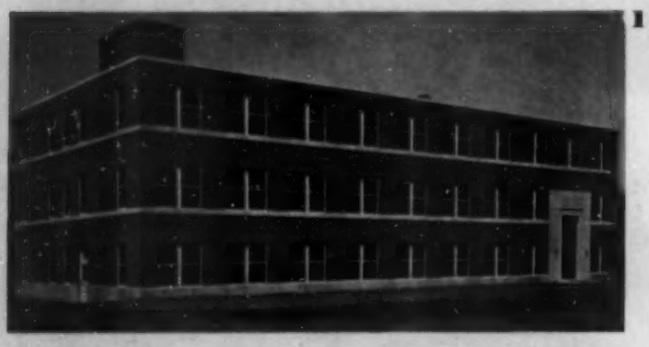
The exterior, as may be seen from the drawing, follows the trends laid down by leading industrial architects. Although the building is truly functional in every respect, appearance has not been neglected. Lines of concrete, separating bands of windows, give the building a clean trim appearance.

Coincidentally with the completion of the new plastics laboratory and the construction of the plant, an extensive research program has begun on phenolic materials. While at present these resins are used in everything from molded office equipment to the bonding of plywood, efforts will be made to carry their utility even further. With the facilities now available, intensive work will be carried on in a number of different directions, the company informs us.

Since their development as the first thermosetting plastic over 30 years ago, phenolics have found acceptance in a continually broadening field. Their uses have so rapidly expanded that it is scarcely possible to enumerate them.

The introduction of newer materials and methods of fabrication has not deterred the technical and marketwise development of phenolics. The constant work of research laboratories and development staffs in finding improved resins, better compounds and new uses for them has enabled them to continue to expand their uses. A number of new machines and improved techniques are aiding this work. Completely automatic molding machines and transfer molding techniques are examples. These are important in evaluating the future of phenolic plastics.

1



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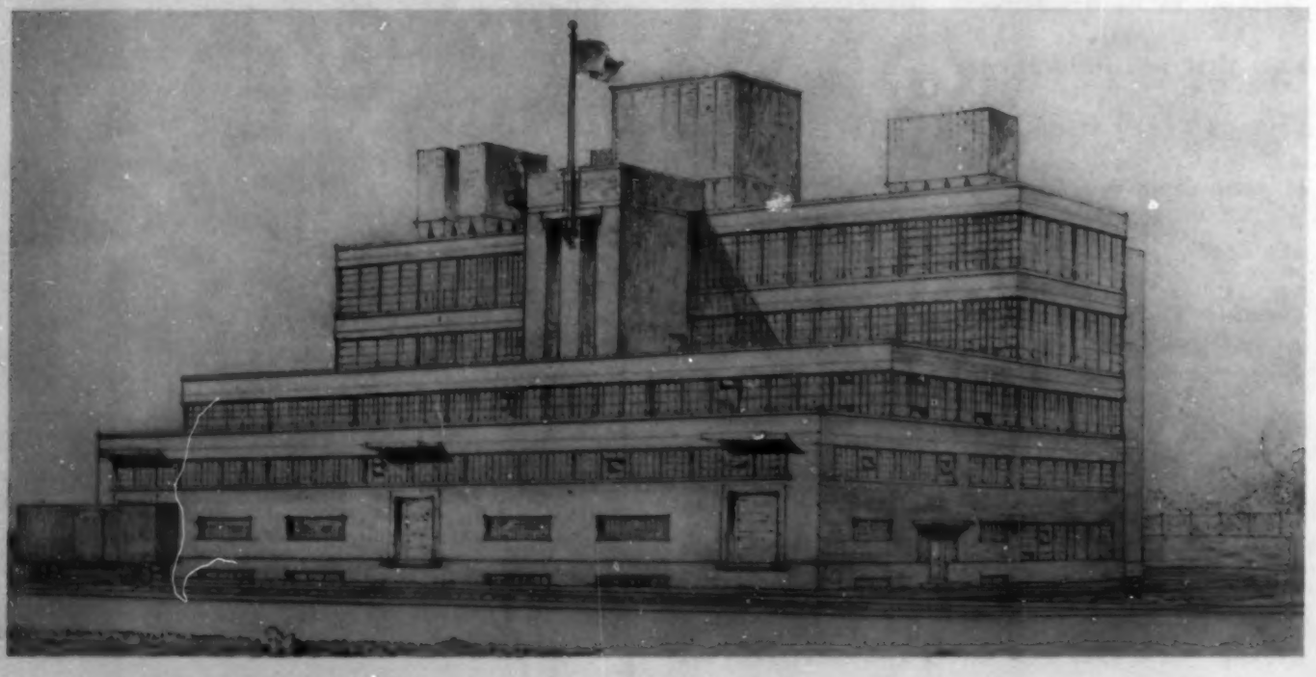

1—At left is the newly constructed modern plastics research laboratory of the Monsanto Chemical Co. 2—The architect's drawing of the projected Resinox plant under construction at Springfield, Mass., adjoining the company's present buildings there

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for cutting down

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for cutting and coloring

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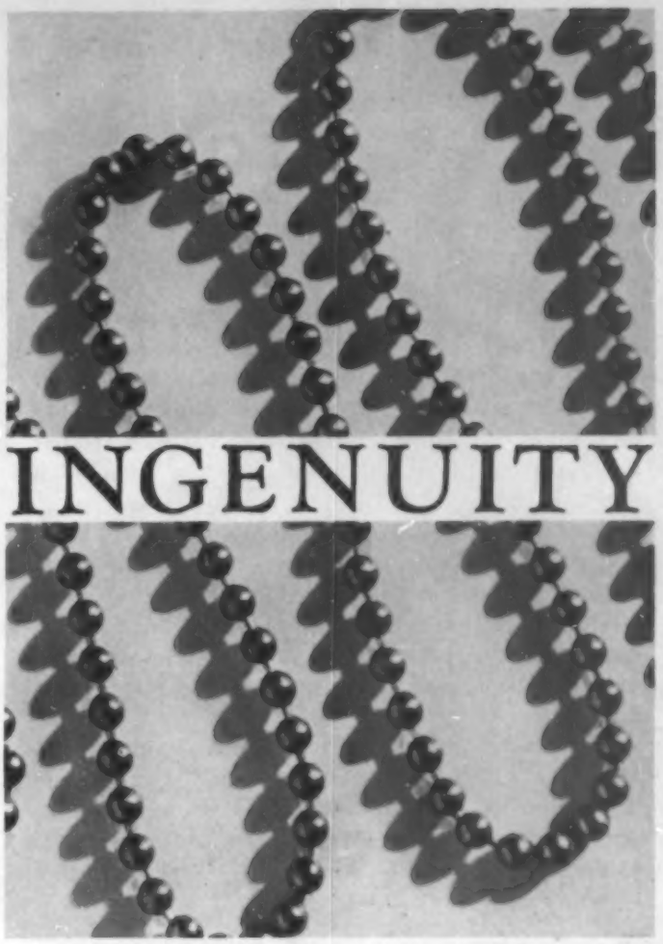

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Molded airplanes for defense

(Continued from page 31)

The process is simple, quick and inexpensive, and adaptable to mass production of airplanes. Once the wooden forms, which can be used repeatedly, are completed, neither skilled labor nor expensive tools are required to make the airplane bodies. Both plastic and veneer are inexpensive and available. Streamlining and curving is no more costly and difficult than flat work. The structures can be completed at but a fraction of the labor and material cost of the present-day fabrication and assembly methods it is claimed. They report that their latest wing design, recently load tested, is 40 percent lighter than present day comparable airplane wings.

Both thermosetting and thermoplastic types of bonding agents have been used. Excellent results have been achieved with interlayer sheets of vinyl butyral resin.

The company has by the Vidal process successfully molded reinforced fuselages, wings, elevators, flaps, ailerons, stabilizers, vertical fins, nacelles, bomb doors, floats and various types of controls.

Plastic-plywood wings made by the company have withstood strength, weathering and vibration tests. They have fulfilled the commercial factor of safety requirement of $6\frac{1}{2}$ and Army safety factor of 9. The seamless feature of the Aircraft Research fuselage is important. The fuselage from fireboard to tail tip acts as a single unit. A commercial plane equipped with 75 hp. motor will cruise at about 95 miles per hour, but the Summit plane constructed by the Vidal process, equipped with the same power will cruise at 125 miles per hour because all surface contours are smoother, conforming more closely to aerodynamic lines. The company awaits final governmental approval before producing the first 100 units of this class of plane, now on order. Incidentally, craft of this type would serve excellently as military trainers.

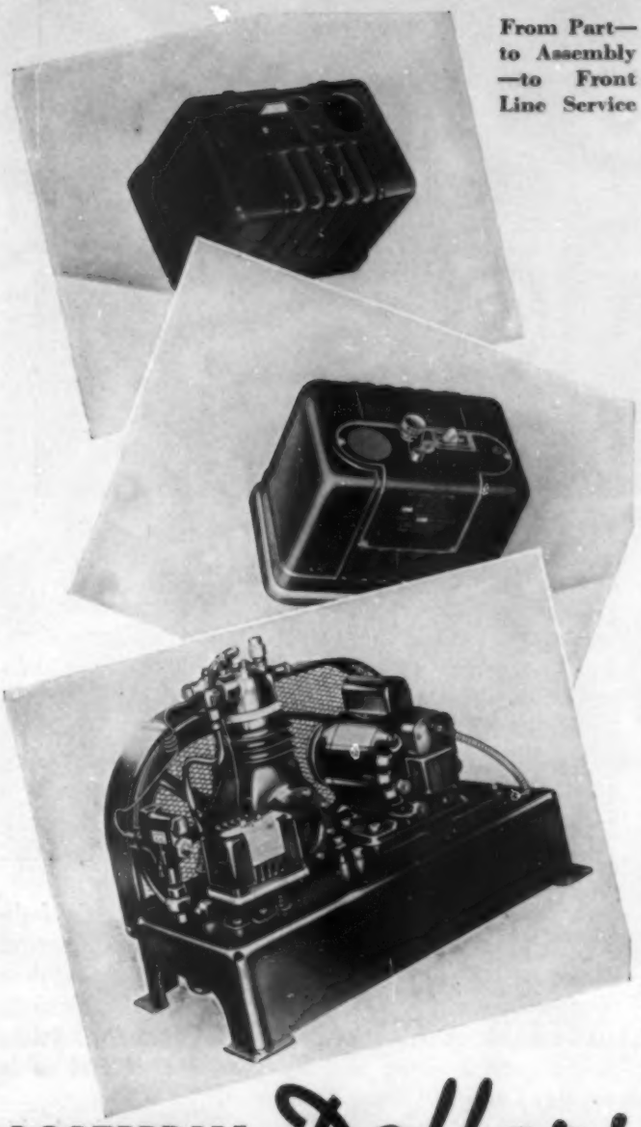
Large-scale production by this method is possible. A process licensee, who is using this method, is manufacturing dinghys and small sailing boat hulls with modest plant facilities at the rate of 15 units per day.

Timm Aircraft Company

The *Aermold* process has been under development over the past two years by the Timm Aircraft Co. of Van Nuys, California, and technical phases are being directed by Mr. Walter A. Hite. This firm recently flew its first plastic-plywood plane. The ship is a primary trainer conforming to Air Corps and CAA specifications. In its trial flights in stability, maneuverability, in fact in all respects, according to the report, it performed satisfactorily.

The *Aermold* method involves, first, the construction of dies or forms to the desired contours. Then

Rear portion of the engine cowling shown was produced by the Duramold process. Note the comparative smoothness of the material and the absence of rivets and joints, which is desirable in airplane construction, because of the resulting improved performance. (Photo, courtesy Glenn L. Martin Company)



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Saving assembly dollars is one of our first considerations here at Auburn.

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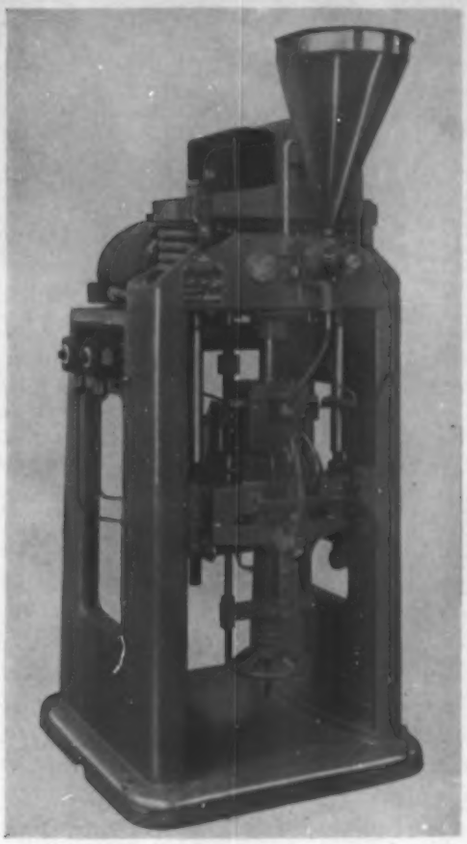

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17

18

17—*Markt Position Protractor made of transparent Pyralin is used for direction finding and plotting course.* **18**—*Propellers, by Engineering & Research Corp. are wood laminated with transparent Lumarith sheet .0050 in. thick, are lightweight and resist stress and strain. They're painted black to reduce glare*

spruce veneers are superimposed one upon another using a thermosetting phenolic resin sprayed or otherwise applied on each layer during the assembling to serve as the bonding agent. The assembled structure is placed in an oven where it is cured. The phenol-formaldehyde resin under heat and slight pressure reacts to become a hard, fast bond. The specially constructed large oven is 10 ft. wide, 10 ft. high and 40 ft. long.

Load tests were recently conducted on horizontal tail surfaces similar to those used in the Timm Trainer. These were loaded to 120 percent of the design load. At the tip the maximum deflection was 1.38 in. When the load was removed, it was observed there was no measurable permanent set. Timm has made no effort to design for minimum weight since it is most interested in manufacturing economy.

The *Aermold* process normally contemplates that surfaces will be bonded in the oven or cooker within an hour after the bonding agent has been applied. In the event that the bonding material has begun to harden, it may be restored to normal operating consistency by treating with a thin film of water. Subassemblies are normally subjected to temperatures of 100 deg. F. to accelerate the setting properties of the binder. Complete assemblies are placed in the oven at a temperature of approximately 180 deg. F. for a period of two hours. During this time, strict attention is given to careful humidity control.

The baking process results in all of the various elements being fused into a single mass. The result is a smooth, light, efficient plastic-plywood structure. Pressures on the tank for the cure range from 50 to 150 lbs. per sq. inch according to the amount of impregnation desired. Timm manufacture is not as yet on a large-scale production basis. The preliminary experimental work has been completed and has indicated promising possibilities in this direction.

Miscellaneous aircraft use of plastics

Apart from the use of constructing such basic structures as fuselages, wings, floats or spars from plastic plywood, plastics have been extensively used for subassemblies, such as functional units and for instruments. In these instances plastics are used as they are customarily treated, either molded or fabricated.

Navigation instruments frequently have compression-molded phenol-formaldehyde housings, where electrical properties are a consideration phenolic types have served ideally. Instruments using laminated materials with phenol-formaldehyde binders have been found to be satisfactory.

In earlier aircraft where open cockpits were the fashion, cellulose nitrate sheet stock was used for cowl windows. It still suits many purposes. Cellulose acetate has largely supplanted cellulose nitrate chiefly on account of its slow-burning qualities. Cellulose acetate sheets serve well for wind shields and cabin windows on small commercial craft.

One type of plastic material which has received wide acceptance by airplane manufacturers generally is acrylic resin sheets. Because of its exceptional optical properties, because of ease in forming, on account of its exposure stability and because of its shock resisting properties acrylic resin is an ideal window material. Both the Army and Navy use it extensively.

Coatings of a durable nature for plastic plywood parts are of essential importance. Synthetic resins of the phenol-formaldehyde series have been developed which fulfill the specifications of moisture resistance, of sub-tropical exposure tests, and of deflection resistance. They also withstand surface cracking and peeling. These coatings have a common basis with some of the materials which are used in manufacturing plastic-plywood of the structural type.

Among the other well-established uses of plastics are pulleys, knobs, instrument and switch panels, cable guides, ducts, spacers and radio masts.

An important technological transition has accompanied the evolution of the plastic-plywood plane. As such, there has never been constructed a true "plastic" plane. If the present plastic-plywood aircraft had any semblance of a prototype it was the veneer plane;

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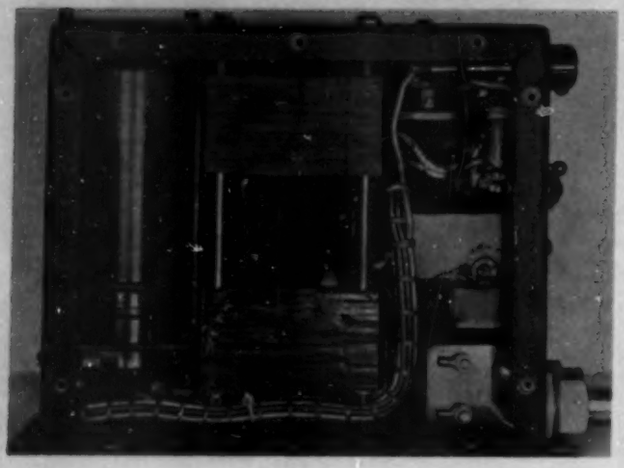
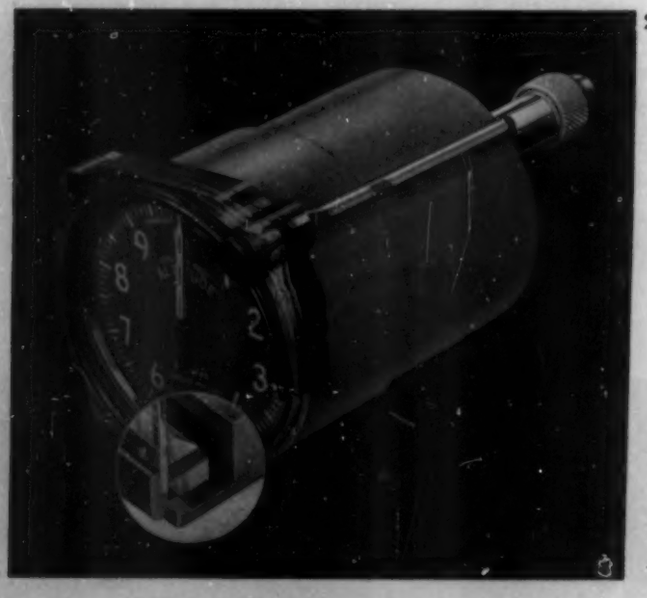
19



20

19—Antenna housing formed of transparent Lumarith sheet. 20—Pioneer Instrument, Div. of Bendix Aviation Corp., makes extensive use of molded and laminated plastics for terminal boards and supports in this Autosyn Vibrator power supply unit. 21—(below) In this Pioneer Sensitive altimeter (altitude gage) molded phenolic is used for the entire case and for the plug cover. Inset shows the molded window ring used to conduct light around the rim of the dial and a transparent molded ring which permits the entrance of light into the instrument's pressure-tight chamber



21

this old-time plywood plane was fabricated with flat pressed plywood in which the veneers were glued together under pressure in flat conventional presses. The shortcomings of this method were many. The casein adhesives used were subject to fungi attack. Changing atmospheric conditions often caused plywood to resume its original shape, the layers to part and the surface to deteriorate. Spilled gasoline or oil had a deleterious effect.

The fundamental bases for the current progress in plastic-plywood have been the development of a satisfactory forming or molding method, the development of satisfactory inert bonding agents, the improvement of finishers, the economy of processing, the low cost of construction and the superior aerodynamic qualities.

Paralleling the progress made in the plastic plywood materials has been the improvement of the surface coatings or finishes, for both inside and outside protection. Various types of synthetic sealers and sprayers are in use and development work is going forward to see if the drying time of coatings can be reduced to facilitate greater production speed.

The present urgent demand prompted by the national defense program has accelerated developments. The manufacturers of plastic-plywood, it is reported, are delivering sub-structures to meet exacting aerodynamic specifications. Complete planes are undergoing tests on the rough anvil of experience. The industry is preparing for the increasing demands which are confronting it. A program of intensive research is under way, and the plastic manufacturers are actively cooperating by furthering research development.

The costume jewelry way

(*Continued from page 35*) from strips of laminated woven wood veneer, as well as crystal-clear methyl methacrylate bracelets and pins decorated with artistically carved patterns.[2] Seen in great profusion at the moment are two and three strand necklaces and bracelets of methyl methacrylate in a new translucent pearl tone. These satiny smooth pieces have an iridescent tenor that is most flattering to smartly simple outfits. They come in jewelry colors such as sapphire, ruby and "tiger eye" brown and in natural smoke-gray and white, as well as chartreuse, pink, blue and fuchsia.

Although they may not be recognized as such, many of the "jewels" set in inexpensive trinkets are really injection molded of polystyrene.[3] Precisely faceted, they sparkle with a brilliance exceeded only by the real thing. They compare favorably with glass and undoubtedly will help fill in for the imitation stones which are no longer available from European countries.

Right now it looks as though plastics were tops in the realm of costume jewelry, and progressive manufacturers who carefully follow style trends with well-designed pieces in popular colors, should have little difficulty in keeping them there.

[2] Modern Plastics, April 1940, page 48.
[3] Modern Plastics, November 1940, page 79.

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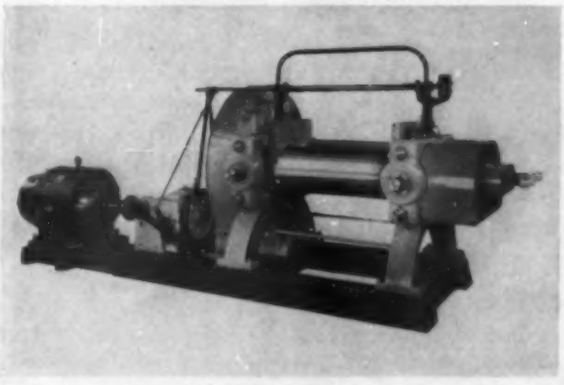

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AND
PLASTIC
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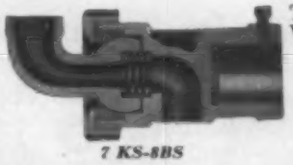

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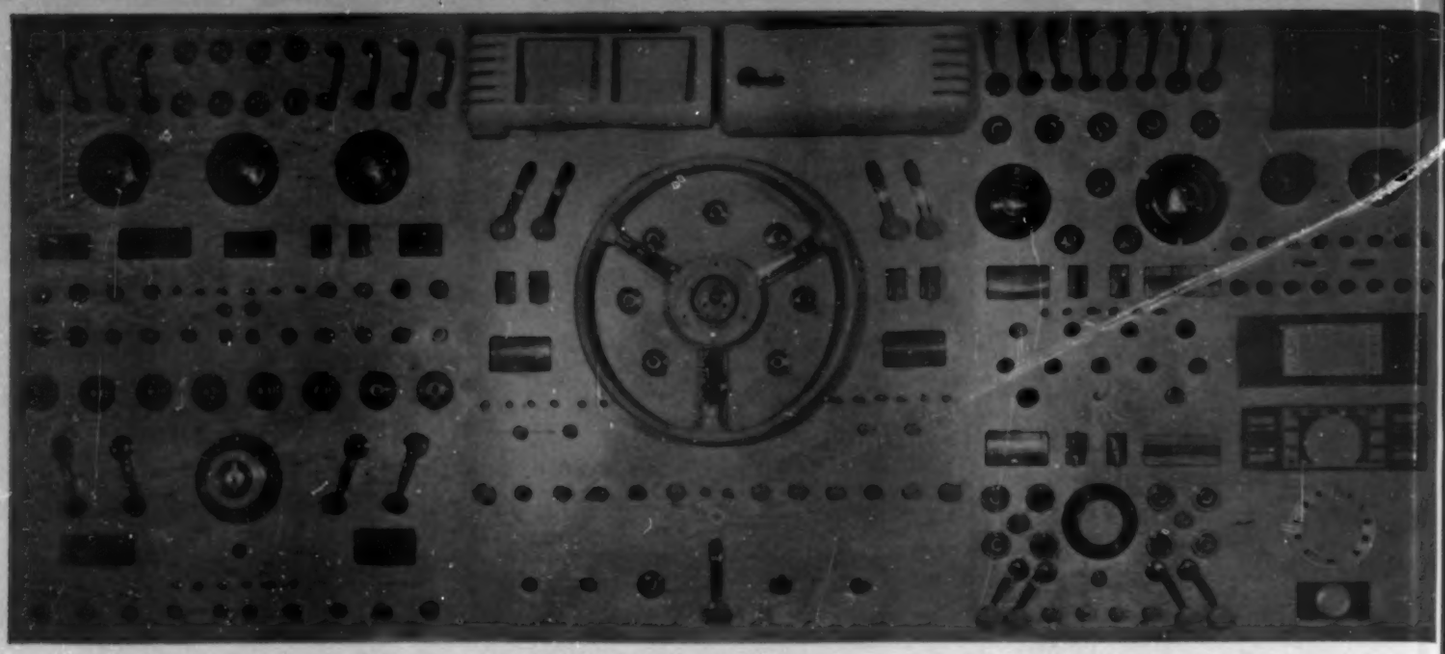

Display panel showing variety of plastic parts used on a recent model Chrysler

History of Plastics

(*Continued from page 53*) higher working capacity, greatly lessen labor and power costs in operation. Some of the early applications of plastics in aircraft were simply carry-overs from automobile design, while others have grown out of striving to solve new problems. Distributor heads, magnetos, conductor terminals, switches, instrument housings, and terminal sleeves are among aircraft parts being made with the use of phenolic materials. In airplane radio sets, panels, tube sockets, condensers, mountings, coils, binding posts, knobs and dials are being made of phenolic plastics. Laminated canvas-phenolic material is used for cable pulleys and bushings. These laminated products were used about twenty years ago for airplane propellers, and their use for the hub portion of the new wood-plastic propeller was described to the Society of Automotive Engineers at its Annual Meeting one year ago.

Summary of information regarding phenolic molding plastics:

Outstanding properties: Dimensional stability, electrical insulating qualities, heat resistance, moldability, resistance to chemicals, thermal hardening, water resistance.

Forms available: Molding powders of various special types, such as general purpose, non-bleeding, heat-resistant, extrusion, high impact, arc-resistant, closure, moisture-resistant, high dielectric, acid-resistant, alkali-resistant, friction-resistant, sanding, and buffing.

Method of fabrication: Molded in hardened steel molds at 280 deg. to 350 deg. F. and a pressure of 2000 lbs. per sq. in. or more, the cure requiring 30 seconds to several minutes depending on the compound used and the size and shape of the piece to be molded.

Typical applications: Automotive and airplane parts, camera cases, closures, corrosion-resistant apparatus, electrical insulation, handles, housings, telephone equipment.

Trade names and manufacturers:

Bakelite—Bakelite Corp., 247 Park Ave., New York, N. Y.

Durez—Durez Plastics and Chemicals, Inc., N. Tonawanda, N. Y.

Durite—Durite Plastics, Philadelphia, Pa.

Indur—Reilly Tar and Chemical Corp., New York, N. Y.

Makalot—Makalot Corp., Boston, Mass.

Resinox—Resinox Corp., Div. of Monsanto Chemical Co., Springfield, Mass.

Textolite—General Electric Co., Plastics Dept., Pittsfield, Mass.

Summary of information regarding laminated phenolic plastics:

Outstanding properties: Chemical inertness, durability, high tensile, compressive, and impact strengths, electrical insulating qualities, resistance to spotting and discoloration, translucency in some grades.

Forms available: Sheets, rods, tubes, fabricated parts.

Method of fabrication: Parts may be machined or punched from laminated stock; decorative laminates are sometimes furnished as thin veneers for cementing to less expensive cores.

Typical applications: Bearings, gears, electrical apparatus, radio equipment, trays, table tops, refrigerator doors, wall coverings, doors, counter and cabinet paneling, translucent and opaque signs.

Trade names and manufacturers:

Dilecto—Continental Diamond Fibre Co., Newark, Del.

Formica—Formica Insulation Co., Cincinnati, Ohio.

(*Please turn to next page*)

For their superb Wondereel, The Shakespeare Company use bakelite endplates molded by Kurz-Kasch . . . get strength without excessive weight, split-hair accuracy, absolute uniformity, appealing color (black, maroon, green) and economy.

No Backlash!

"Backlash" is a fisherman's name for trouble. Users of plastic parts have troubles, too. Inaccuracies, imperfections, faulty design, slow service, poor materials — these constitute the "backlash" of the plastic business. What Shakespeare has done for fishermen, Kurz-Kasch does daily for users of plastic parts. Ends backlash! For the facts on how it's done, refer your next problem to Kurz-Kasch.

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●

WANTED: CELLULOSE ACETATE SCRAP, unground or reground, as well as lumps, also acrylic or methacrylic resin scrap and celluloid scrap. Send details concerning quantities and price. Reply Box 318, Modern Plastics.

●

FOR IMMEDIATE SALE: 18 Semi-Automatic Hydraulic Presses —300 Ton, 18″ Ram, 30″x25″ & 27″x25″ Platens, 2500#. 125 Ton, 12″ Ram, 23″x17″ Platens, 2500#. Large stocks Hydraulic Presses, Pumps & Accumulators. Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizers, Tumbling Barrels, Drill Presses, Lathes, Gas Boilers, etc. Send for Bulletin #156 and #128. We also buy your surplus machinery for cash. Reply Box 359, Modern Plastics.

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FOR SALE: Battery of Semi-Automatic Presses, 75 to 400 ton, complete with pull-backs and ejectors; 60″ Mixing Rolls; 7—Gould Triplex Hydraulic Pumps, 3—1500 PSI, 35 GPM, 4—3000 PSI, 18 GPM; 2—Watson-Stillman 4-cylinder opposed Hydraulic Pumps, 6000 lb. PSI, 25 GPM motor driven, 100 HP AC motors; Watson-Stillman Hydro-Pneumatic Accumulator, 8″ ram, 48″ stroke, 42″ air cylinder, 5000 lb. PSI, complete with high pressure air receiver and inter-connecting fittings. Reply Box 360, Modern Plastics.

ENGRAVER SEEKS A CONNECTION in permanent capacity in the mold and die building dept. of molding concern. Am well-experienced with the type of engraving work required on molds and hobs for the production of plastics. Also able to manage own department. Reply Box 369, Modern Plastics.

●

FOR SALE: Isoma Injection Molding Machine, 1/2 oz. capacity. Perfect working condition. This machine is available for inspection. Reply Box 370, Modern Plastics.

●

Machinery builders interested in entering plastic field or improving present product write for information new combination Injection-Compression molding press—new low price press designs—new molding methods, etc. G. W. Wacker, Consulting Engineer, 4616 Reading Rd., Cincinnati, O.

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Consultant in Plastics has machine and method of production using low cost powders and competing with injection molding in quantity production. Much less cost for materials, dies and equipment. Want to arrange to have machines made and leased to users. Reply Box 371, Modern Plastics.

●

Well established firm with showrooms and sales organization in Boston, Mass. Also woodworking factory and machine shop in New Hampshire wants connection with stock molders and suppliers of plastic materials for turning, stamping, machining, combining, lacquering, finishing, etc. Arrangements for sales agencies also considered. Reply Box 372, Modern Plastics.

●

WANTED: Used, single-cavity, hand molds, for medium drawn parts such as ash trays, to be used for research. Submit price and sample part. Reply Box 373, Modern Plastics.

Insurok—Richardson Co., Chicago, Ill.
Lamicoid—Mica Insulator Co., New York, N. Y.
Micarta—Westinghouse Electric and Manufacturing Co., Micarta Div., Trafford, Pa.
Ohmoid—Wilmington Fibre Specialty Co., East Wilmington, Del.
Panelyte—Panelyte Corp., New York, N. Y.
Phenolite—National Vulcanized Fibre Co., Wilmington, Del.
Spauldite—Spaulding Fibre Co., Tonawanda, N. Y.
Synthane—Synthane Corp., Oaks, Pa.
Taylor—Taylor Fibre Co., Norristown, Pa.
Textolite—General Electric Co., Plastics Dept., Pittsfield, Mass.

Casein plastic

Formaldehyde-hardened casein plastic was discovered in Europe and its manufacture begun about 1900, but its commercial development in this country did not get under way until after the original patents had expired. It is, therefore, considered in this chronological review of American plastics at this juncture rather than preceding the cold-molded and phenolic plastics. The French claim to have made the first formaldehyde-hardened casein plastics about 1893, but the basic patent covering the production of a tough, insoluble horn-like mass from casein by the action upon it of formaldehyde was taken out by two Germans, Krische and Spitteler, in 1900.[18] Production began almost immediately in Germany and France under the trade name *Galalith*, meaning milk stone, and was followed by manufacture in England about 1914. The first successful casein plastic development in the United States was that of the Aladdinite Co. in 1919, and by 1925 four other American firms were in this business. However, many of the applications of this material which are practical in Europe were found to be impracticable in this country because of marked variations in our climate throughout the year. The casein plastics industry has, therefore, declined in the last decade in this country, both in number of producing units and in volume of production, other than for button manufacture.

The primary limitation on its more extensive use is its hygroscopicity which leads to warping and cracking of the plastic when subjected to wide variations in relative humidity. In the early twenties it was used in automobiles as horn buttons, pushbuttons, and other interior accessories, but it has long since been supplanted by more stable materials for these applications.

Mention should also be made here of the research and development work which is under way to utilize proteins from sources other than milk as raw materials for plastics. Chief among these are soybean protein and zein obtainable from corn. The hygroscopicity which characterizes casein is an inherent property of proteins in general and before these materials can be molded into useful articles of appreciable size a method or reagent must be found to overcome this defect. Of course, the addition of a high percentage of phenolic resin will accomplish this end, but in such a case it becomes largely a matter of which two hygroscopic materials, cellulose (woodflour) or a protein, will serve best as a cheap diluent and reinforcing agent for the resinous molding compound. To date, woodflour is the only organic filler commonly used in powders sold on the open market.

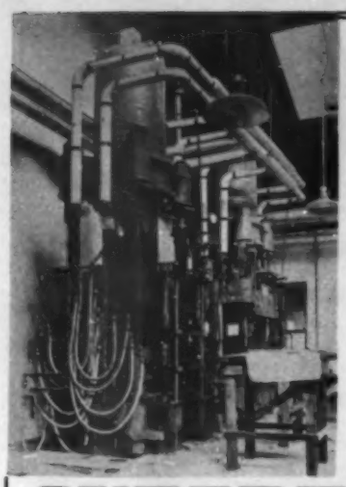
Summary of information regarding casein plastic:

Outstanding properties: Colorability, ease of machining, ease of polishing, hygroscopicity, nonflammability.
Forms available: Sheets, rods, tubes, disks.
Methods of fabrication: Articles are cut or ground to desired shapes from sheets, rods, tubes, and disks; buttons and other small pieces are molded to shape and immersed in formaldehyde to chemically harden the plastic.
Typical applications: Beads, buckles, buttons, game counters, novelties, trimming accessories.
Trade names and manufacturers:
Ameroid—American Plastics Corp., New York.
Galorn—Geo. Morrell Corp., Muskegon Hts., Mich.

This brings us to 1925 in our chronological review of plastics development in the United States. Five plastics were serving the market of that day, namely, pyroxylin, shellac, cold-molded, phenolic, and casein compositions. It is noteworthy that of these five plastics developed during these first 55 years of the industry in America, only one was destined to forge ahead to new records of production and application during the period from 1925 to 1940. These fifteen years were to witness the introduction of more than twice that many new plastic compositions and more than a fivefold increase in the quantity of plastics produced annually. No addition to the list of new materials was made in 1925, but this year did mark the appearance of the first periodical in the United States devoted exclusively to the plastics field. This periodical, *Plastics*, was the predecessor of the magazine, MODERN PLASTICS, which serves the industry today.

The first review of the uses of plastics in the motor car, as noted at the 1926 Automobile Show in New York, appeared in the fifth issue of *Plastics*. The applications mentioned included balls for gearshift levers, handles on cigar lighters and doors, distributor, innumerable switches, frames for the interior lights, pushbuttons, timing gears, frames for instruments, instrument boards, steering wheels, battery cases, windows and windshields, artificial leather type of upholstery, and pyroxylin lacquers over the bodies. Considering this list, it appears that very little progress has been made in extending the applications of plastics in automotive construction during the 15 years that have elapsed since that first review was published. The materials used have changed and a vast improvement has been accomplished in the aesthetic appeal and

[18] U. S. P. 646,844; Ger. P. 127,942.



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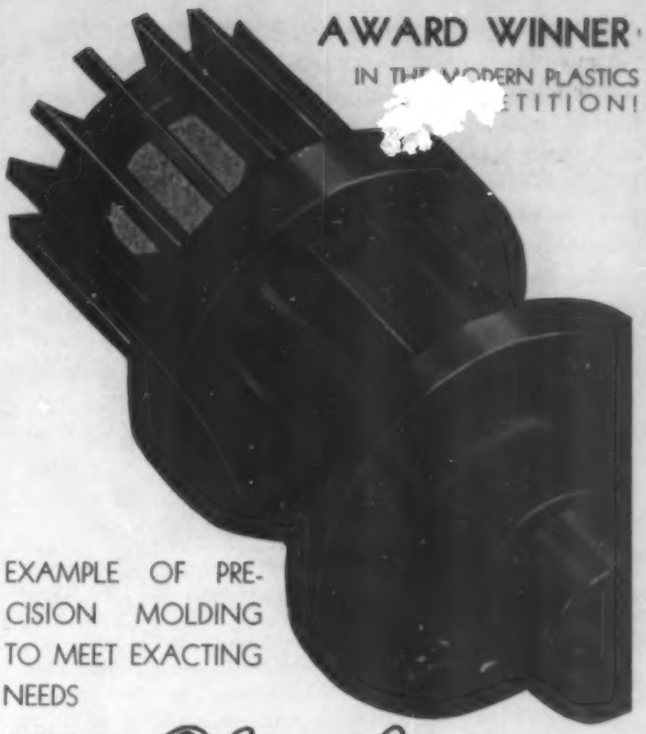

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durability as well as the economical production of the various plastic parts, but advances beyond merely decorative interior moldings have been few. Window frames, glove compartment doors, and head-lamp shells have been the major contributions of recent date. Plastic fenders and a molded body still remain as the greatest prospective field for extension of the uses of plastics in the automobile. Among other potential applications of plastic moldings in engine and chassis are the following parts, according to a recent tabulation:[17] tappet covers, rocker covers, wheelcases, sump, water pump rotor, water pump bushes, oil pumps, rockers, cam wheels, chain wheels, fan blades, camshaft bearings, main bearings, connecting rod bearings, oil seals, king pin bushes, thrust washers, steering joint brake cross-shaft bearings, gearbox and rear axle covers, cable conduits, filler caps, and spring interleaves.

The second and third parts of this paper will be presented in the August and September 1940 issues of this publication. Editor.

[17] D. Warburton-Brown, Plastics and the Motor Car. Trans Inst. Plastics Ind. (British), *8*, 7–17 (June 1939).

Extrusion of plastics

(*Continued from page 55*) before building the receiver or conveyor. A more complete discussion of plastics materials which can be used for extrusion is contained in subsequent paragraphs.

The wind-up

Small flexible extruded shapes, i.e., tubing or rod, frequently may be wound into coils upon leaving the conveyor and cooler. If an automatic wind-up is provided for this purpose, it must be so designed that it maintains a peripheral speed corresponding to that of the conveyor, in order to avoid stretching the plastic shape at the point near the die opening where it is soft and pliable. Rigid or large section extrudings generally cannot be wound without deformation and must be cut into the desired lengths.

The material

Plastics for extrusion should be specifically designed for that purpose. In some materials they are available in grades ranging from soft, through tough and flexible, to hard and rigid. These are formulated to make the extrusion temperature range as wide as possible, and to promote retention of shape while cooling.

In all cases of extrusion, the plastic must be dry for best results. The presence of a very small amount of moisture in the hot extruding section is sufficient to cause blistering and roughness. Complete dryness of material is even more important in extrusion than it is in injection molding.

Most of the thermoplastics, with the exception of the cellulose nitrate group, can be hot-extruded by the method described. However, certain of the others require a special technique. The vinyl chloride polymers and co-polymers can be extruded in properly designed machines and yield products which vary from the hard, rigid and brittle type to those which exhibit remarkable toughness and flexibility. Cellulose acetate plastics also can be extruded; in fact, they have been fabricated in this manner for years. However, webbing for the upholstery of lawn furniture, now a currently popular application for extruded plastics, has been made possible by the availability of extrusion materials of greater weather resistance.

Control and distribution of heat

The plastic extrusion machine is so arranged that the die holder, and head, body and feed sections can be heated separately. This makes for flexibility in control. Some materials behave better if the feed section of the machine is cooled. In some cases, it is heated only by conduction from the adjoining sections, but for materials requiring the greatest amount of heat to become plastic, it may be heated to any temperature within the range of the heating system. In general, it has been found best to decrease temperatures progressively from die holder to feed. This may be done by passing the heating medium through the sections in series, with the input at the die end. A considerable gradation of temperature can be secured by reducing the amount of heat transfer medium pumped through the system. Since each plastic has its characteristic behavior and heat requirements, no general rule can be formulated for materials and sections.

Extrusion technique

The technique for plastic extrusion differs somewhat from that for rubber in which the feed strip is often thoroughly pre-warmed on a mill, the extrusion machine serving principally to form the strip into the desired shape. The plastic extruder is longer than that used for rubber, the additional length being required for the heating and working of the mass into a homogeneous state. In order to realize the full benefit of the longer tube, it should be kept filled at all times. Otherwise, the in-going plastic may be rapidly forced along the tube, with little working, until it meets the back pressure from the die. While very small single strip extrusions may be made in this manner, and actually may be better for the shorter time allowed in the heating zone, it is obvious that the maximum capacity of the machine can be obtained only if the entire heating area is utilized by keeping it full.

In order to keep the inventory low when using a machine at low-capacity output, a carefully adjusted feed for the plastic granules is required. The rapidity of the revolution of the extrusion screw is not necessarily reflected directly in the quantity of the machine's output, since some slippage of material back along it is always present. This becomes greater in relation to the discharge through the die as screw speeds are increased and viscosity is reduced. In extreme cases, a regurgita-

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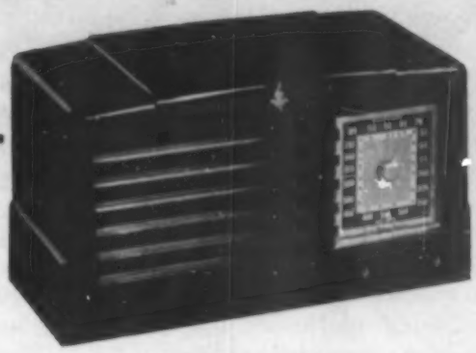

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LITTLE GIANT TOGGLE PRESS

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It has a long stroke and a wide working range. The head is equipped with knockout. All wearing parts, pins, and links are hardened.

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tion of softened plastic into the feed opening may result, thus, occasioning unsatisfactory operation. Such difficulty is not likely to occur if the die opening is large and head pressure is relatively low.

Conclusion

It is practically impossible to describe all the conditions necessary to the proper extrusion of plastics, and any discussion must be limited to a description of processes in general. Requiring good control and at times considerable mechanical ingenuity, extrusion is capable of producing forms of regular cross section continuously, economically and with very little waste. It is a process with great promise, one which should be—and in the light of present developments probably will be—used far more generally than heretofore has been the case.

An article on construction and operating features of these extrusion presses will appear in the 1941 MODERN PLASTICS CATALOG.

Meeting engineering demands

(*Continued from page 38*) place. The third opening runs right through the depth of the cap and fits snugly around a metal cylinder, which on the foremost container, leads to the faucet, and is a terminal on the rear container. The entire cap measures 6 in. in overall diameter, including the $^3/_4$-in. corner projections which are clamped fast to the outer rim of china cylinders. The bottom of the cap is recessed to fit securely beneath the china rim, for a tight seal.

Special care in the molding of the caps was essential to provide the close tolerances, firmness and maximum clarity demanded. The time required for the molding operation is quite long as the piece has to be cooled right in the mold and then removed cold, in order to prevent crazing or distortion of the plastic. After removal from the press, the molded part, already cooled, is sent to the finishing department for removal of fins and polishing.

Broken ice floats in water that surrounds the containers. A thermometer which shows the exact temperature inside the cooling unit can be read through the top. Brilliant green neon illumination floods the cabinet interior. This gives a striking, cool effect that is enhanced by the reflections from the floating ice, and lights up the area around the unit.

Design of the system, according to the Whiting Corp., was aimed at the most sanitary construction, ease of cleaning and high counter-pressure to seal in the natural carbonic gases in the beer. Considerable experimentation, we are told, preceded the selection of the material for the caps. Immunity to taste and odor, freedom from chemicals that might have an adverse effect on the brew, durability and, of course, transparency were basic considerations. Further, a material that could be readily threaded and produce a firm, highly polished finished product was desirable from an engineering standpoint.

For super-speed service

(*Continued from page 37*) rior for such applications. A more complete treatment of the subject of plastic bearing materials with greater data on physical properties and performance tests and technical details was presented in the May 1940 issue of this publication.[1]

Case histories

1. A grinding spindle was equipped with high-speed laminated retainer bearings. Previously, spindle speed had been limited due to the inadequacy of other bearings. With the installation of the plastic retainers, spindle speed was increased, resulting in a step-up of production from 17 to 65 pieces an hour. In addition, the finish of the product was improved.

2. A high-speed grinding spindle with a precision laminated retainer has been in operation for 15 months without a shutdown. Even after this amount of severe service, the grinder bearings have suffered so little wear that the machine is still turning out work with a tolerance of half a ten-thousandth of an inch.

3 Another company reports that they have been able to eliminate a rough grinding operation which had previously been necessary before finish grinding. The fineness and accuracy of the super-precision bearing made this possible.

4. A grinding operation had previously required bearing replacement after slightly over 2000 hours of service. Super-precision bearings installed on this grinder have established service records of over 3000 hours; an increase of 50 percent in bearing life.

In these days of industrial speed-up and production economies, plastic laminates assume a new importance in the manufacture and maintenance of precision high-speed equipment, not overlooked nor underestimated.

[1] L. M. Tichvinsky, Properties and Performance of Plastic Bearing Materials, MODERN PLASTICS, *17*, No. 9, p. 54.

Precision assembly—18 parts

(*Continued from page 43*) To assure rapid, accurate assembly, parts are held to tolerances of 0.001 in. to 0.004 in., depending on the part. The assembly consists of: 1 case, 1 back, 8 switches, 1 switch bracket, 1 voltmeter case, 1 vacuum-compression gage case, 2 molded transparent lenses, 1 neon tube panel, 1 thermocouple and 1 solvent cup.

The case itself represents an unusual example of plastic molding because of its deep draw, side cores and horizontal bosses. It is complete even to the metal tapped inserts. Housing and cover are each produced in a single operation with all constructional and decorative details complete.

Some of the manufacturing features that saved money for the customer were nearly contrived. The best examples are: metal inserts for cover screws; threaded inserts for supporting bracket; countersunk bosses for cable terminals; metal inserts for tube nipples; and

Is one (or more) of these a "finish problem" in your plant?

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Avoid Spoilage *and* Cut Finish Costs *with this*

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Avoid heating and discoloring. Sand down to feather edge.

Now! Put your plastic finish work on a "Line Production" basis—get high volume production without appreciable waste or "spoilage." Use PORTER-CABLE Wet Belt Sander-Grinder! With this new finish method you can *for the first time* depend on elimination of plastic flow, heating, chipping, discoloring, fracturing and warping of the materials.

This New PORTER-CABLE Wet Belt Sander-Grinder cuts faster and cleaner, on either flat or irregular surfaces—washes "fill-up" from abrasive belt—provides 3 times longer belt-life. Write us *today* about *your* finish problems! Send samples. Ask for our suggestions for better finish at *lower cost!*

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Sinko injection molding operations are standardized to the highest possible degree. For instance, *every one* of our big battery of presses are of the same manufacture. All of the molds we make can be used on *any* of our machines. This saves a lot of time. For, in plants where different makes of presses are used, jobs must frequently wait the completion of a prior run before they can be placed on the press for which the mold was specially constructed. This is only one of many reasons for the unusual speed, efficiency and economy of SINKO Injection Molding service. May we tell you more about it?

Sinko
PRECISION INJECTION MOLDING

SINKO TOOL AND MANUFACTURING CO.
351 NORTH PULASKI ROAD, CHICAGO, ILL.
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CHIKSAN
High Temperature SWING JOINTS

Style No. 10
With 3 Swivels

At last—a reliable Swing Joint for operation under high temperatures! No packing glands or stuffing boxes to repack or keep tight!

For Operation at Temperatures Up to 700° F. Pressure to 500 Lbs.

Specially designed Packing Set, not affected by steam or chemicals. Packing Chamber chromium-plated and polished to provide a smooth, long wearing surface. Easy turning. Made in 6 styles.

REPRESENTATIVES IN PRINCIPAL CITIES
Distributed Nationally by
CRANE CO.

CHIKSAN BALL BEARING SWING JOINTS

CHIKSAN TOOL COMPANY
BREA, CALIFORNIA

YOU'RE THE DOCTOR

The M.D. does not guess at temperatures. Neither should a manufacturer who is concerned with production costs. The use of a Cambridge Pyrometer permits the safe speeding up of the cure without the danger of scorching. Models available for determining temperatures of moving rolls, molds and within-the-mass.

The Cambridge is also made with an extension attachment to reach inaccessible places.

Cambridge Instrument Company, Inc.
3732 Grand Central Terminal
New York, N. Y.

CAMBRIDGE
Surface Needle Mold
PYROMETERS

Send for folder describing these Pyrometers. They will help you save money and make a better plastics.

concave cavity and holes for tube terminals. All of these were incorporated in the molding operation thereby eliminating many costly finishing processes. Other finishing steps cut out in this skillfully planned molded process were: boring, tapping, drilling, forming, grooving, slotting, counterboring and welding. To go even further, color spraying and polishing are eliminated as the jet-black finish is permanently part and parcel of the plastic. The company's identifying lettering is embossed on the cover during molding. Assembly of the several molded parts is simplified because parts are fewer and more accurately formed.

Although light in weight, this instrument is sturdy, will withstand constant handling without marring and endure the impact shocks encountered in everyday service station use. Constant contact with grease, gasoline, moisture and heat—even engine de-gumming solvents, does not affect the working of the device or harm its surface. Its heat and electrical insulation make it safe to use.

Molded plastics and sound construction combine to reduce manufacturing costs, satisfy precision requirements and afford important merchandising features.

More about plastics patents

(*Continued from page 46*) of the casting box and is forced into the casting box through the channels *22* by the closing of the cover or ram *19*, this plastic material passing through the ports in the top flange *6* of the shell *5* and into the space between the outer face of the matrix, and this forcing of the material is continued until the cover or ram is closed, at which time the cylindrical space between the matrix and the shell *5* will be completely filled with the plastic material, and consequently a cylindrical printing plate of phenolic condensation product having an impression-producing or printing surface complementary to the molding face of the matrix will be produced. Heat is applied to the casting box during the molding operation, and after the molding operation has been completed, the casting box is allowed to cool or is cooled to hasten the hardening or setting of the plate, and which cylindrical or tubular plate is indicated in the drawings by the numeral *25*. The casting box may now be opened and the shell with the matrix and the plate lifted therefrom."

Seaworthy pump

(*Continued from page 39*) whole unit is held together by six screws through the case itself. Motor fields are placed in recessed lugs which hold the motor in place when the two cases are bolted together. Inserts are used to hold the switch parts and to assemble the terminal screws. The identification of the voltage is accomplished by hot stamping between the terminals, insuring a permanent identification.

Another feature of the bilge pump to avoid trouble to the motor from the briny atmosphere, is a stainless steel armature shaft, preventing any possible binding in the bearings as a result of corrosive action. Likewise, the rivets on the breaker points are of monel metal, with pure tungsten points for the contacts. The other switch parts are manufactured of a highly corrosion-resistant bronze.

In order that the electrical properties of the pump may be definitely separated from the water, the universal connecting the motor to the impeller shaft is made of synthetic rubber, a chloroprene polymer, which will remain hard and firm, unaffected by the gasoline and oil present in the bilge. The design of the float also cuts off the switch from the water as it is made of hard sponge rubber—a sealed cell type which will retain its floating properties even if the float should become damaged. The float is connected directly to the switch by a vertical hard rubber float rod molded integrally with the float and reinforced by a wire through the center. The rod is square to hold the float in one position. It was possible to protect the float by placing the screen around it. This reduced the chance of floating boards striking the mechanism and damaging the pump.

An important component of the Fleming pump is its *sway-proof* switch—a device which provides for the roll of the boat. The pump stays on until the pump job is completed and does not just flicker on and off with every wave. It goes into action when the water rises to one inch and keeps pumping until all water is forced out.

When installing the pump, it is screwed to the keel of the boat. This offered a breakage problem. To overcome this, a metal plate is screwed onto the base of the pump with a second plate on the inside of the casings. This spreads the load out over a large enough area to be safe from cracking. The outlet connections of the pump are made with rubber hose to reduce danger of damage.

The company makes the new electric bilge pumps in two models—automatic and manually operated. The automatic motor-controlled unit handles 70 gallons per ampere hour of battery used (which is remarkable efficiency). It will pump up to 8 ft. high, and is designed for boats up to fifty feet, either sail or motor. It is compact and fits the small spaces found on many boats—the floor area being $5\frac{1}{2}$ in. by $3\frac{1}{2}$ in. and its height, 10 inches. Whether it is left a day or a month at its mooring, the automatic model will pump out bilge water without constant attendance. The *sway-proof* switch turns the pump on and off so that the bilge is kept dry.

Before this bilge pump was made in plastics, its sales possibilities were investigated by the company by selling a bronze pump for one year at a popular price. They report that this proved without a doubt that the market was there for runs long enough to pay for the molds. With the use of plastics, not only were the specifications for particular and superior physical properties accomplished but a more attractive pump was produced of an improved design, incorporating service features not possible with metals. Without raising manufacturing cost, function and sales appeal were achieved through plastics.

New Worlds for Old

WITH CATALIN

THE GEM OF PLASTICS

Cabinet fabricated by
Plastic Turning Co., Inc.
Leominster, Mass.
for the
Anthony Martinek Devices, Inc.
Allentown, Pa.

Radio time and accurate time have become synonymous in the modern household. In the new "Radio-Numeral Clock" shown above, Anthony Martinek Devices have smartly combined an efficient receiver and synchronized timepiece in a Catalin cabinet of simplicity, charm and unusual acoustical properties.

Catalin cabinets, like all Catalin adaptations, have a beauty all their own. Their limitless range of colors appeals to the designer and decorator. Their economical cost of production and ease of manufacturing have won the approbation of Industry. And their brilliant, enduring finish and "quality" atmosphere have earned for them an enviable place in our American homes.

When YOUR product sallies forth to conquer brave, new worlds, clothe it in Catalin! We'll be glad to show you how.

CATALIN CORPORATION
ONE PARK AVENUE · NEW YORK

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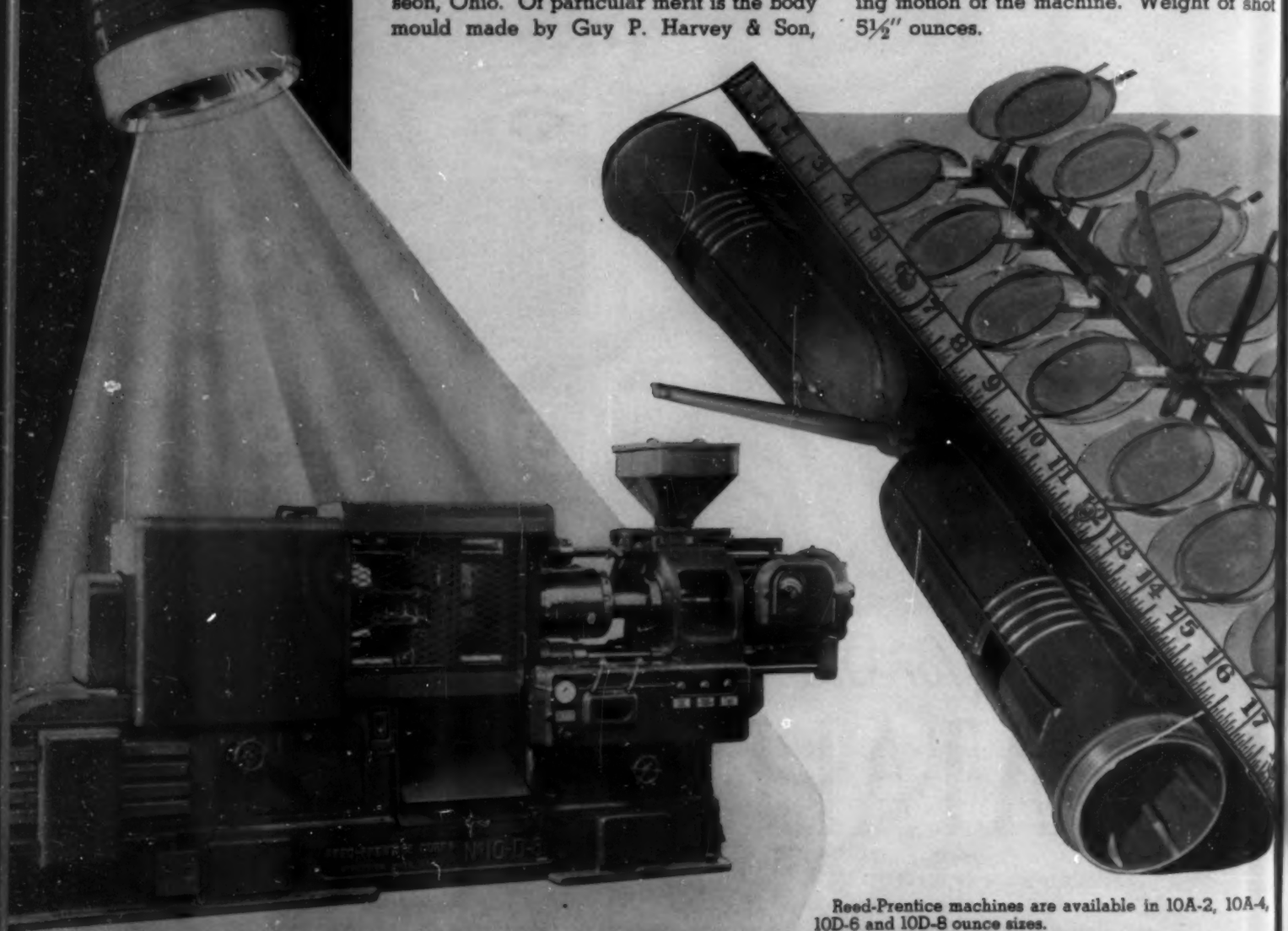
REED-PRENTICE

IN THE SPOTLIGHT!

Here's an outstanding job by REED-PRENTICE 10D-6 OZ. MACHINE

Flashlight bodies, lenses, threaded caps and buttons all moulded by Peerless Moulded Plastics Company, Toledo, Ohio, for the Fulton Manufacturing Corporation, Wauseon, Ohio. Of particular merit is the body mould made by Guy P. Harvey & Son, Leominster, Mass., 54" long to mould 2 bodies at one time and provides for positive side draw of 8" for cores actuated automatically through rack and pinion by opening motion of the machine. Weight of shot 5½" ounces.



Reed-Prentice machines are available in 10A-2, 10A-4, 10D-6 and 10D-8 ounce sizes.

Reed-Prentice features covered by patents pending.

REED-PRENTICE CORPORATION

WORCESTER, MASS., *Main Office and Works*

OVER 290 MACHINES IN SUCCESSFUL OPERATION